



# Special Issue on Ontologies and Data Management: Part II

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## 1 Introduction

We welcome the readers to Part II of the special issue on Ontologies and Data Management, an issue dedicated to the foundations of employing logic-based ontologies in data management scenarios. The first part of this special issue was published in September 2020 as Issue 3 of Volume 34 (see [15] for an overview of its content).

We recall that the publication of this body of works is motivated by the progressively relevant challenge of managing information in the world where increasingly large amounts of loosely structured data are becoming available, e.g., due to the integration of information from heterogeneous data sources. It is acknowledged that traditional relational database tools and techniques alone are not sufficient to address this challenge, but complementing them with new techniques rooted in Knowledge Representation (KR) is believed to be a viable way to alleviate the problem. KR is an active research area of Artificial Intelligence (AI) that is developing methods for representing complex human knowledge in various formalisms, equipped with automated reasoning methods for a computer to draw useful conclusions from the represented knowledge. We recall that in this special issue we are mostly interested in knowledge captured in ontologies, expressed in Description Logics (DLs) as well as various rule-based languages. For a broader introduction to the area, we encourage an interested reader to see the dedicated survey [14]. DLs and rule-based languages are two prominent families of formalisms used in knowledge representation, yet they are orthogonal in many ways, and have their own advantages and disadvantages. DLs are more suitable for structuring knowledge and data, an advantage

that has led DLs to be used as the logical foundation for the OWL family of ontology languages recommended by the World Wide Web Consortium (W3C). In contrast to DLs, rules are very suitable for expressing various information needs, which is witnessed by their use as query languages for relational databases (DATALOG being the most prominent rule-based query language). For this reason, understanding ways of combining the strengths of DLs and rule-based languages is an active research area, which we touch upon in this part of the special issue [1, 4, 6–9]. In contrast to standard rule-based languages, in DLs one usually makes the open-world assumption, which is suitable for constructing generic, reusable, data-independent ontologies. In rule-based languages usually the closed-world assumption is made in order to draw some common-sense conclusions from the concrete available data. Combining the closed-world and the open-world assumptions naturally leads to non-monotonic reasoning over DL ontologies, which is another focus topic of the second part of the special issue [11, 16]. A prerequisite for the practical use of logic-based ontologies in data management is the ability to manage logical inconsistencies, which can easily arise due to human errors during the construction of ontologies, or due to the integration of information coming from incompatible data sources. This topic is closely related not only to non-monotonic reasoning but also to the ability to explain logical entailments and non-entailments in DL ontologies. This broad area is also represented in this special issue [3, 10, 12]. Finally, we note that there is a strong connection between rule-based languages and the Horn fragment of first-order logic, and thus various Horn DLs are also discussed here [9, 13].

We would like to sincerely thank everybody who helped realize this special issue, which was a challenging task, not least because of the ongoing COVID-19 crisis. We thank the authors and the reviewers for their efforts and patience, which resulted in a substantial collection of high quality works. We also thank Anni-Yasmin Turhan and the support team at Springer for helping us manage the preparation of this special issue. The work of Mantas Šimkus was

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## 2 Overview of Part II

Similarly to its predecessor, Part II of this special issue features technical contributions, system descriptions, abstracts of PhD and habilitation theses, project reports, and an interview with Diego Calvanese, a pioneer of Ontology-based Data Access. We now give a brief overview of the contributions in each category.

In her short survey [3], Bienvenu provides an overview of the literature on inconsistency handling for ontology-mediated query answering, a topic which has received increased attention in recent years. The contribution [6] by Carral et al. develops an approach for encoding complex reasoning algorithms for description logics in a declarative way in rule languages such as Datalog and its extension with sets, Datalog(S). In their contribution [7], Gogacz et al. provide a new proof for the decidability of the all-instances chase termination problem in the context of linear tuple-generating dependencies (TGDs), which are important in ontological query answering. Mugnier's contribution [9] provides an overview of the semantic relationships between two major families of ontology languages relevant for data access, namely Horn description logics and existential rules. The contribution [10] by Peñaloza studies the problem of deriving meaningful consequences from ontologies which contain known errors, extending ideas from inconsistency-tolerant reasoning.

The system description [4] by van Bremen et al. presents onto2problog, a tool for ontology-mediated querying of probabilistic data via probabilistic logic programming engines, which supports a large part of the OWL 2 EL profile. In [8], Kasalica et al. give an overview of the NoHR reasoner, which answers queries over combinations of an ontology using operators from any of the three OWL 2 profiles, and a set of non-monotonic rules. In [12], Pukancová and Homola introduce AAA, a sound and complete ABox abduction solver for OWL 2 ontologies that supports multiple observations.

The PhD thesis abstract [11] describes Pensel's contributions to rational reasoning in defeasible description logics. In [1], Ahmetaj describes her research into query rewriting in ontology-mediated query answering (OMQA), extending previously studied settings with closed predicates, expressive ontology languages, and SPARQL queries. OMQA is also the subject of Sabellek's PhD thesis, which is summarised in [13] and studies several reasoning problems related to OMQA in Horn description logics. Varzinczak's habilitation thesis abstract [16] reports on the author's work on defeasible description logics, a family of non-monotonic

extensions of standard DLs designed for reasoning with uncertainty.

The project report [2] by Baader et al. describes the investigation into reasoning in temporal, fuzzy, and/or probabilistic extensions of ontology languages designed for detecting situations from data in an ontology-mediated way, carried out in the DFG funded project "Semantic Technologies for Situation Awareness".

The interview with Diego Calvanese provides a glimpse into his background, the origins of his productive research at the intersection of KR and Database Theory, the efforts to transform foundational research results into industry-grade tools, as well as into his view of the future developments.

## 3 Content

### 3.1 Technical Contributions

- A short survey on inconsistency handling in Ontology-Mediated Query Answering [3]  
Meghyn Bienvenu
- Reasoner = Logical Calculus + Rule Engine [6]  
David Carral, Irina Dragoste and Markus Krötzsch
- All-Instances restricted chase termination for linear TGDs [7]  
Tomasz Gogacz, Jerzy Marcinkowski and Andreas Pieris
- Data access with horn ontologies: where existential rules and description logics meet [9]  
Marie-Laure Mugnier
- Error-tolerance and error management in light-weight description logics [10]  
Rafael Peñaloza

### 3.2 System Descriptions

- onto2problog: a Probabilistic Ontology-mediated Querying System using Probabilistic Logic Programming [4]  
Timothy van Bremen, Anton Dries and Jean Christoph Jung
- NoHR: an overview [8]  
Vedran Kasalica, Matthias Knorr, João Leite and Carlos Lopes
- The AAA ABox Abduction Solver [12]  
Júlia Pukancová and Martin Homola

### 3.3 Thesis Abstracts

- A lightweight defeasible description logic in depth-quantification in rational reasoning and beyond [11]  
Maximilian Pensel

- Rewriting approaches for Ontology-Mediated Query Answering [1]  
Shqiponja Ahmetaj
- Ontology-mediated Querying with Horn Description Logics [13]  
Leif Sabellek
- Defeasible Description Logics [16]  
Ivan Varzinczak

### 3.4 Project Reports

- Semantic Technologies for Situation Awareness [2]  
Franz Baader, Stefan Borgwardt, Patrick Koopmann,  
Veronika Thost and Anni-Yasmin Turhan

### 3.5 Interviews

- Interview with Diego Calvanese [5]

## 4 Service

We recall here the main venues for disseminating works on the use of ontologies in data management, especially involving automated reasoning.

### 4.1 Conferences, Workshops, and Summer Schools

- AAAI Conference on Artificial Intelligence (AAAI)
- Alberto Mendelzon International Workshop on Foundations of Data Management (AMW)
- International Workshop on the Resurgence of Datalog in Academia and Industry (Datalog 2.0)
- International Workshop on Description Logics (DL)
- International Workshop on Nonmonotonic Reasoning (NMR)
- European Conference on Artificial Intelligence (ECAI)
- International Joint Conference on Artificial Intelligence (IJCAI)
- International Conference on Database Theory (ICDT)
- International Semantic Web Conference (ISWC)
- European Conference on Logics in Artificial Intelligence (JELIA)
- International Conference on Principles of Knowledge Representation and Reasoning (KR)
- ACM–IEEE Symposium on Logic in Computer Science (LICS)
- International Conference on Principles of Database Systems (PODS)
- International Joint Conference on Rules and Reasoning (RuleML+RR)

- Reasoning Web Summer School (RW)

### 4.2 Journals

- Journal of Artificial Intelligence Research
- Artificial Intelligence
- ACM Transactions on Computational Logic

## References

1. Ahmetaj S (2020) Rewriting approaches for ontology-mediated query answering. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00671-w>
2. Baader F, Borgwardt S, Koopmann P, Thost V, Turhan AY (2020) Semantic technologies for situation awareness. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00694-3>
3. Bienvenu M (2020) A short survey on inconsistency handling in ontology-mediated query answering. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00680-9>
4. van Bremen T, Dries A, Jung JC (2020) onto2problog: a probabilistic ontology-mediated querying system using probabilistic logic programming. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00670-x>
5. Calvanese D, Šimkus M (2020) Interview with Diego Calvanese. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00691-6>
6. Carral D, Dragoste I, Krötzsch M (2020) Reasoner = logical calculus + rule engine. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00667-6>
7. Gogacz T, Marcinkowski J, Pieris A (2020) All-instances restricted chase termination for linear tgds. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00690-7>
8. Kasalica V, Knorr M, Leite J, Lopes C (2020) NoHR: an overview. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00650-1>
9. Mugnier ML (2020) Data access with Horn ontologies: where description logics meet existential rules. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00678-3>
10. Peñaloza R (2020) Error-tolerance and error management in lightweight description logics. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00684-5>
11. Pensel M (2020) A lightweight defeasible description logic in depth. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00644-z>
12. Pukancová J, Homola M (2020) The AAA Abox abduction solver. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00685-4>
13. Sabellek L (2020) Ontology-mediated querying with Horn description logics. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00674-7>
14. Schneider T, Šimkus M (2020) Ontologies and data management: a brief survey. *KI-Künstliche Intell* 34(3):329–353. <https://doi.org/10.1007/s13218-020-00686-3>
15. Schneider T, Šimkus M (2020) Special issue on ontologies and data management: part I. *KI-Künstliche Intell* 34(3):287–289. <https://doi.org/10.1007/s13218-020-00682-7>
16. Varzinczak I (2020) Defeasible description logics. *KI-Künstliche Intell.* <https://doi.org/10.1007/s13218-020-00649-8>