A brief guided tour along the borders of Logic Programming with Description Logics

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Abstract

Logic Programming (LP) (14) and the family of Description Logics (DLs) (1) are both based on fragments of First Order Logic (FOL). However, they are characterized by different semantic assumptions (16; 9). Yet, a partial overlap exists between LP and DLs which allows the extension and/or adaptation of known results in LP to DLs and viceversa (5; 17; 7; 8). Even more interestingly, a combination of the two is possible via several integration schemes that are aimed at designing very expressive FOL languages and ultimately overcoming the aforementioned semantic mismatch between LP and DLs (2; 10; 19; 15; 4; 3). Several works in Inductive Logic Programming (ILP) (born at the intersection between LP and concept learning (18)) testify the great potential of these hybrid knowledge representation formalisms also from the perspective of machine learning and inductive reasoning (20; 6; 11; 12; 13).

This tutorial talk surveys the literature of the last 20 years concerning the combination of (I)LP and DLs with a particular emphasys on the integration issues. The aim is to show how many interesting things happen or could happen along the borders of LP with DLs.

References

F. Baader, D. Calvanese, D. McGuinness, D. Nardi, and P.F. Patel-Schneider, editors. *The Description Logic Handbook: Theory, Implementation and Applications*. Cambridge University Press, 2003.

Francesco M. Donini, Maurizio Lenzerini, Daniele Nardi, and Andrea Schaerf. $\mathcal{AL}$-log: Integrating Datalog and Description Logics. *Journal of Intelligent Information Systems*, 10(3):227–252, 1998.

Thomas Eiter, Giovambattista Ianni, Thomas Lukasiewicz, and Roman Schindlauer. Well-founded semantics for description logic programs in the semantic web. *ACM Transactions on Computational Logic*, 12(2):11, 2011.

Thomas Eiter, Giovambattista Ianni, Thomas Lukasiewicz, Roman Schindlauer, and Hans Tompits. Combining answer set programming with description logics for the semantic web. *Artificial Intelligence*, 172(12-13):1495–1539, 2008.

Benjamin N. Grosof, Ian Horrocks, Raphael Volz, and Stefan Decker. Description logic programs: combining logic programs with description logic. In *Proceedings of the 12th International World Wide Web Conference*, pages 48–57. ACM, 2003.

Jörg-Uwe Kietz. Learnability of description logic programs. In Stan Matwin and Claude Sammut, editors, *Inductive Logic Programming, 12th International Conference, ILP*

2002, Sydney, Australia, July 9-11, 2002. Revised Papers, volume 2583 of *Lecture Notes in Computer Science*, pages 117–132. Springer, 2003.

Markus Krötzsch, Sebastian Rudolph, and Pascal Hitzler. Description logic rules. In Malik Ghallab, Constantine D. Spyropoulos, Nikos Fakotakis, and Nikolaos M. Avouris, editors, *ECAI 2008*, volume 178 of *Frontiers in Artificial Intelligence and Applications*, pages 80–84. IOS Press, 2008.

Markus Krötzsch, Sebastian Rudolph, and Pascal Hitzler. Complexities of horn description logics. *ACM Trans. Comput. Log.*, 14(1):2, 2013.

Markus Krötzsch, Sebastian Rudolph, and Peter H. Schmitt. A closer look at the semantic relationship between datalog and description logics. *Semantic Web*, 6(1):63–79, 2015.

Alon Y. Levy and Marie-Christine Rousset. Combining Horn rules and description logics in CARIN. *Artificial Intelligence*, 104:165–209, 1998.

Francesca A. Lisi. Building Rules on Top of Ontologies for the Semantic Web with Inductive Logic Programming. *Theory and Practice of Logic Programming*, 8(03):271–300, 2008.

Francesca A. Lisi. Inductive Logic Programming in Databases: From Datalog to $\mathcal{DL}$+log. *Theory and Practice of Logic Programming*, 10(3):331–359, 2010.

Francesca A. Lisi. Learning onto-relational rules with inductive logic programming. In Jens Lehmann and Johanna Völker, editors, *Perspectives on Ontology Learning*, volume 18 of *Studies on the Semantic Web*, pages 93–111. IOS Press/AKA, 2014.

John W. Lloyd. *Foundations of Logic Programming*. Springer, 2nd edition, 1987.

Boris Motik and Riccardo Rosati. A faithful integration of description logics with logic programming. In M.M. Veloso, editor, *IJCAI 2007, Proc. of the 20th Int. Joint Conf. on Artificial Intelligence*, pages 477–482, 2007.

Boris Motik and Riccardo Rosati. Reconciling description logics and rules. *J. ACM*, 57(5), 2010.

Boris Motik, Ulrike Sattler, and Rudi Studer. Query Answering for OWL-DL with Rules. *Journal on Web Semantics*, 3(1):41–60, 2005.

Shan-Hwei Nienhuys-Cheng and Ronald de Wolf. *Foundations of Inductive Logic Programming*, volume 1228 of *Lecture Notes in Artificial Intelligence*. Springer, 1997.

Riccardo Rosati. $\mathcal{DL}$+log: Tight Integration of Description Logics and Disjunctive Datalog. In P. Doherty, John Mylopoulos, and Christopher A. Welty, editors, *Proc. of Tenth International Conference on Principles of Knowledge Representation and Reasoning*, pages 68–78. AAAI Press, 2006.

Céline Rouveirol and Véronique Ventos. Towards Learning in CARIN-$\mathcal{ALN}$. In James Cussens and Alan M. Frisch, editors, *Inductive Logic Programming, 10th International Conference, ILP 2000, London, UK, July 24-27, 2000, Proceedings*, volume 1866 of *Lecture Notes in Artificial Intelligence*, pages 191–208. Springer, 2000.