Feeding Many Values to Lightweight Description Logics

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Among the many languages proposed for knowledge representation and reasoning, the lightweight description logic (DL) $\mathcal{EL}$ [1] has received special attention. Due to its good computational behaviour—with polynomial-time reasoning problems—this logic is well suited for representing large knowledge domains. Moreover, despite its relative inexpressivity, it has been successfully used for representing biological and medical knowledge, as can be witnessed in the NCBO BioPortal.[1] In its classical form, $\mathcal{EL}$ cannot handle the imprecision that is intrinsic to biological and medical terminology, thus providing an imperfect use of the knowledge expressed in the existing knowledge bases. One way to overcome this limitation is to consider fuzzy and many valued extensions of $\mathcal{EL}$.

Just as fuzzy extensions of expressive DLs easily become undecidable [3], allowing intermediate truth degrees causes an increase in the complexity of reasoning in many cases [2]. Conversely, there are also many extensions of $\mathcal{EL}$ that remain tractable [4, 5].

In this talk we explore what is known about fuzzy extensions of $\mathcal{EL}$, going beyond questions of computational complexity. We will consider the many existing open questions, along with some conjectured answers. The questions, however, will easily outnumber the answers.

References

[1] Franz Baader, Sebastian Brandt, and Carsten Lutz. Pushing the $\mathcal{EL}$ envelope. In Leslie Pack Kaelbling and Alessandro Saffiotti, editors, *Proc. of the 19th Int. Joint Conf. on Artificial Intelligence (IJCAI'05)*, pages 364–369. Professional Book Center, 2005.

[2] Stefan Borgwardt, Marco Cerami, and Rafael Peñaloza. The complexity of subsumption in fuzzy $\mathcal{EL}$. In Qiang Yang and Michael Wooldridge, editors, *Proc. of the 24th Int. Joint Conf. on Artificial Intelligence (IJCAI'15)*, pages 2812–2818. AAAI Press, 2015.

[3] Stefan Borgwardt, Felix Distel, and Rafael Peñaloza. The limits of decidability in fuzzy description logics with general concept inclusions. *Artificial Intelligence*, 218:23–55, 2015.

[1] http://bioportal.bioontology.org/

[4] Stefan Borgwardt and Rafael Peñaloza. Positive subsumption in fuzzy $\mathcal{EL}$ with general t-norms. In Francesca Rossi, editor, *Proc. of the 23rd Int. Joint Conf. on Artificial Intelligence (IJCAI'13)*, pages 789–795. AAAI Press, 2013.

[5] Theofilos Mailis, Giorgos Stoilos, Nikolaos Simou, Giorgos B. Stamou, and Stefanos Kollias. Tractable reasoning with vague knowledge using fuzzy $\mathcal{EL}^{++}$. *Journal of Intelligent Information Systems*, 39(2):399–440, 2012.