# Preferential Extensions of Lightweight Description Logics


Laura Giordano[1], Valentina Gliozzi[2], Nicola Olivetti[3], Gian Luca Pozzato[2]

[1] Dipartimento di Informatica
Università del Piemonte Orientale "A. Avogadro"
laura@mfn.unipmn.it

[2] Dipartimento di Informatica
Università degli Studi di Torino
gliozzi,pozzato@di.unito.it

[3] LSIS-UMR CNRS 6168
Université "Paul Cézanne"
nicola.olivetti@univ-cezanne.fr


In our recent research we have continued our investigation on nomonotonic extensions of Description Logics (DLs). We have proposed some extensions of standard DLs with a typicality operator $\mathbf{T}$, whose meaning is that, for any concept $C$, $\mathbf{T}(C)$ singles out the instances of $C$ that are considered as "typical" or "normal". The semantics of the typicality operator $\mathbf{T}$ turns out to be strongly related to the semantics of nonmonotonic entailment in KLM logic $\mathbf{P}$. In our setting, we assume that the TBox element of a KB comprises, in addition to the standard concept inclusions, a set of inclusions of the type $\mathbf{T}(C) \sqsubseteq D$, where $D$ is a concept not mentioning $\mathbf{T}$.

In our recent research, we have applied our approach based on the $\mathbf{T}$ operator to the so-called *lightweight* Description Logics, focusing on the logic $\mathcal{EL}^{+^{\perp}}$ of the well known $\mathcal{EL}$ family. The logics of the $\mathcal{EL}$ family allow for conjunction ($\sqcap$) and existential restriction ($\exists R.C$). Despite their relatively low expressivity, these logics are relevant for several applications, in particular in the bio-medical domain; for instance, medical terminologies, such as the GALEN Medical Knowledge Base, the Systemized Nomenclature of Medicine, and the Gene Ontology, can be formalized in extensions of $\mathcal{EL}$.

In [3, 1, 2], we have introduced a DL called $\mathcal{EL}^{+^{\perp}}\mathbf{T}$. In this logic a KB may contain, for instance:

$$\mathbf{T}(\mathit{Dog}) \sqsubseteq \mathit{Affectionate}$$
$$\mathbf{T}(\mathit{Dog}) \sqsubseteq \mathit{CarriedByTrain}$$
$$\mathbf{T}(\mathit{Dog} \sqcap \mathit{PitBull}) \sqsubseteq \mathit{NotCarriedByTrain}$$
$$\mathit{CarriedByTrain} \sqcap \mathit{NotCarriedByTrain} \sqsubseteq \bot$$

corresponding to the assertions: typically dogs are affectionate, normally dogs can be transported by train, whereas typically a dog belonging to the race of pitbull cannot; the fourth inclusion represents the disjointness of


*RCRA Incontri e Confronti (RiCeRcA 2009)*
*Giornata del Gruppo di Lavoro in Rappresentazione della Conoscenza e Ragionamento Automatico (RCRA) dell'Associazione Italiana per l'Intelligenza Artificiale (AI*IA)*
*Reggio Emilia, Italy, 12 December 2009*

the two concepts *CarriedByTrain* and *NotCarriedByTrain*. By the properties of $\mathbf{T}$, some inclusions are entailed by the above KB, as for instance $\mathbf{T}(Dog \sqcap CarriedByTrain) \sqsubseteq Affectionate$. In our setting we can also use the $\mathbf{T}$ operator to state that some domain elements are typical instances of a given concept. For instance, an ABox may contain either $\mathbf{T}(Dog)(fido)$ or $\mathbf{T}(Dog \sqcap PitBull)(fido)$. In the two cases, the expected conclusions are entailed: $CarriedByTrain(fido)$ and $NotCarriedByTrain(fido)$, respectively.

We have been able to obtain the following *small model* result for the logic $\mathcal{EL}^{+^\perp}\mathbf{T}$: given an $\mathcal{EL}^{+^\perp}\mathbf{T}$ KB, if it is satisfiable, then there is a model satisfying KB whose size is polynomial in the size of KB. We have also proved that the problem of deciding entailment in $\mathcal{EL}^{+^\perp}\mathbf{T}$ is in co-NP.

## References


[1] L. Giordano, V. Gliozzi, N. Olivetti, and G. L. Pozzato. Prototypical reasoning with low complexity description logics: preliminary results. In F. Lin, T. Schaub, and E. Erdem, editors, *Proceedings of LPNMR 2009 (10th International Conference on Logic Programming and Nonmonotonic Reasoning)*, volume 5753 of *LNAI*, pages 430–436, Potsdam, Germany, September 2009. Springer-Verlag.

[2] L. Giordano, V. Gliozzi, N. Olivetti, and G. L. Pozzato. Reasoning about typicality in $\mathcal{ALC}$ and $\mathcal{EL}$. In Bernardo Cuenca Grau, Ian Horrocks, Boris Motik, and Ulrike Sattler, editors, *Proceedings of the 22nd International Workshop on Description Logics (DL 2009)*, volume CEUR Workshop Proceedings. Vol. 477, pages 24/1–24/13, Oxford, United Kindgom, July 27-30 2009.

[3] L. Giordano, V. Gliozzi, N. Olivetti, and G. L. Pozzato. Reasoning about typicality with low complexity description logics: the logic $\mathcal{EL}^{+^\perp}\mathbf{T}$. In R. Serra and R. Cucchiara, editors, *Proceedings of AI*IA 2009 (XI Conference of the Italian Association for Artificial Intelligence)*, volume 5883 of *LNAI*, pages 62–71, Reggio Emilia, Italy, December 9-12 2009. Springer-Verlag.