Machines with human-like commonsense

Antonio Lieto
University of Turin, Dept. of Computer Science and ICAR-CNR, Palermo, Italy

Abstract

In this talk, I will review the main problems concerning commonsense reasoning in machines and I will present resent two different applications - namaly: the Dual PECCS linguistic categorization system ([Lieto *et al.*, 2015], [Lieto *et al.*, 2016], [Lieto *et al.*, 2017b] [Lieto, 2019] [Lieto, 2014] [Lieto *et al.*, 2017a]) and the TCL reasoning framework ([Lieto and Pozzato, 2020], [Lieto and Pozzato, 2018] [Lieto *et al.*, 2019b] [Chiodino *et al.*, 2020a] [Lieto *et al.*, 2021]) that have been developed to address, respectively, the problem of typicality effects and the one of commonsense compositionality, in a way that is integrated or compliant with different cognitive architectures [Lieto *et al.*, 2017b] [Lieto *et al.*, 2019a], [Chiodino *et al.*, 2020b] thus extending their knowledge processing capabilities [Lieto *et al.*, 2018b] [Lieto *et al.*, 2018a].

In doing so I will show how such aspects are better dealt with at different levels of representation and will discuss how the adoption of a cognitively-inspired approach [Lieto, 2021] can be useful in the design and implementation of the next generation AI systems mastering commonsense.

References

[Chiodino *et al.*, 2020a] Eleonora Chiodino, Davide Di Luccio, Antonio Lieto, Alberto Messina, Gian Luca Pozzato, and Davide Rubinetti. A knowledge-based system for the dynamic generation and classification of novel contents in multimedia broadcasting. *Proceedings of ECAI 2020*, 2020.

[Chiodino *et al.*, 2020b] Eleonora Chiodino, Antonio Lieto, Federico Perrone, and Gian Luca Pozzato. A goal-oriented framework for knowledge invention and creative problem solving in cognitive architectures. *Proceedings of ECAI 2020*, pages 2893–2894, 2020.

[Lieto and Pozzato, 2018] Antonio Lieto and Gian Luca Pozzato. A description logic of typicality for conceptual combination. In *International Symposium on Methodologies for Intelligent Systems*, pages 189–199. Springer, 2018.

[Lieto and Pozzato, 2020] Antonio Lieto and Gian Luca Pozzato. A description logic framework for commonsense conceptual combination integrating typicality, probabilities and cognitive heuristics. *Journal of Experimental & Theoretical Artificial Intelligence*, 32(5):769–804, 2020.

[Lieto *et al.*, 2015] Antonio Lieto, Daniele P Radicioni, and Valentina Rho. A common-sense conceptual categorization system integrating heterogeneous proxytypes and the dual process of reasoning. In *Proceedings of IJCAI 2015*, pages 875–881, 2015.

[Lieto *et al.*, 2016] Antonio Lieto, Enrico Mensa, and Daniele P Radicioni. A resource-driven approach for anchoring linguistic resources to conceptual spaces. In *Conference of the Italian Association for Artificial Intelligence*, pages 435–449. Springer, 2016.

[Lieto *et al.*, 2017a] Antonio Lieto, Daniele Radicioni, Valentina Rho, and Enrico Mensa. Towards a unifying framework for conceptual represention and reasoning in cognitive systems. *Intelligenza Artificiale*, 11(2):139–153, 2017.

[Lieto *et al.*, 2017b] Antonio Lieto, Daniele P Radicioni, and Valentina Rho. Dual peccs: a cognitive system for conceptual representation and categorization. *Journal of Experimental & Theoretical Artificial Intelligence*, 29(2):433–452, 2017.

[Lieto *et al.*, 2018a] Antonio Lieto, William G Kennedy, Christian Lebiere, Oscar Romero, Niels Taatgen, and Robert West. Higher-level knowledge, rational and social levels constraints of the common model of the mind. *Procedia Computer Science*, 2018.

[Lieto *et al.*, 2018b] Antonio Lieto, Christian Lebiere, and Alessandro Oltramari. The knowledge level in cognitive architectures: Current limitations and possible developments. *Cognitive Systems Research*, 48:39–55, 2018.

[Lieto *et al.*, 2019a] Antonio Lieto, Federico Perrone, Gian Luca Pozzato, and Eleonora Chiodino. Beyond subgoaling: A dynamic knowledge generation framework for creative problem solving in cognitive architectures. *Cognitive Systems Research*, 58:305–316, 2019.

[Lieto *et al.*, 2019b] Antonio Lieto, Gian Luca Pozzato, Federico Perrone, and Eleonora Chiodino. Knowledge capturing via conceptual reframing: A goal-oriented framework for knowledge invention. In *Proceedings of the 10th International Conference on Knowledge Capture*, pages 109–114, 2019.

[Lieto *et al.*, 2021] Antonio Lieto, Gian Luca Pozzato, Stefano Zoia, Viviana Patti, and Rossana Damiano. A commonsense reasoning framework for explanatory emotion attribution, generation and re-classification. *Knowledge-Based Systems*, 227:107166, 2021.

[Lieto, 2014] Antonio Lieto. A computational framework for concept representation in cognitive systems and architectures: Concepts as heterogeneous proxytypes. *Procedia Computer Science*, 41:6–14, 2014.

[Lieto, 2019] Antonio Lieto. Heterogeneous proxytypes extended: Integrating theory-like representations and mechanisms with prototypes and exemplars. In *Biologically Inspired Cognitive Architectures Meeting, Advances in Intelligent Systems and Computing*, pages 217–227. Springer, 2019.

[Lieto, 2021] Antonio Lieto. *Cognitive Design for Artificial Minds*. Routledge, 2021.