Catalogue Raisonné: Selected and Commented Papers Listed by Topic

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Abstract

Below I provide a *catalogue raisonné* containing a list selected publications organized by research topic. This list should be intended as complementary (and more informative) with respect to the standard curriculum vitae.

1 Introduction

My research interests are at the intersection of Cognitive Sciences and Artificial Intelligence (AI) [Lieto, 2021]. On these topics I have currently published more than 70 papers in international books, journals (e.g. Journal of Experimental and Theoretical Artificial Intelligence, Journal of Universal Computer Science, Semantic Web Journal, Cognitive Systems Research, Connection Science, Biologically Inspired Cognitive Architectures, etc.) and competitive conferences (e.g. IJCAI, ACM Web Science, ISMIS, FLAIRS, AAAI Fall Symposia, AI*IA, IEEE CISIS etc.). Below I report the main topics of interest and the main related publications.

2 Formal Ontologies and Common-Sense Reasoning

Within the research field at the intersection of cognitive science and knowledge representation I am mainly interested in the study of non monotonic (heuristic) decision making processes with a particular focus on typicality (or commonsense) based reasoning. In my applied research on AI and Knowledge Representation I used the insights coming from the cognitive science (in particular from the cognitive semantics) in order to design, implement and evaluate knowledge representation systems aimed at extending the representational and reasoning capacities of the standard logic-oriented symbolic frameworks (such as the formal ontologies)[1]. Such extensions, presented in my Ph.D. thesis [Lieto, 2012], have been introduced through the proposal of a cognitively inspired hybrid architecture for the representation of knowledge and for its processing starting from the natural language. The theoretical [Frixione and Lieto, 2012], [Frixione and Lieto, 2013] and computational advantages [Frixione *et al.*, 2014] of such approach w.r.t. the classical - logical-based - extensions of standard formalisms are discussed, with different focuses, in different journal and conference publications.

[1]Formal ontologies and ontology building have been also the topic of my master thesis, that was focused on the analysis of automatic and semi-automatic methods for ontology learning [Lieto, 2008].

3 Cognitively Inspired Categorization System

By following the previous line of research an application of the proposed cognitively-inspired knowledge architecture (based on a heterogeneous representational structure and a dual process based reasoning procedure) in the field of Question Answering has been implemented and evaluated in tasks of intelligent concept retrieval based on common sense linguistic descriptions [Lieto *et al.*, 2015a]. A further extension of the proposed framework towards the area of biologically inspired cognitive architectures has been recently proposed [Lieto, 2014], [Lieto *et al.*, 2015b], [Lieto *et al.*, 2016], [Lieto *et al.*, 2017c], [Lieto *et al.*, 2017b] and implemented in the DUAL-PECCS system. This aspect still represents an active area of research interest (see [Lieto, 2019] for the latest extension).

4 Cognitive Architectures

The above mentioned dual process based reasoning framework has been adopted also in cognitive architectures for robotics. In particular, I have collaborated to the dual process based extension of the the PSI cognitive architecture that has been used for the realization of a creative portraitist robot [Augello *et al.*, 2016].

Additionally, within the area of cognitive architectures, my research has been also focused on the knowledge level analysis of the representational limits affecting such AI frameworks [Lieto *et al.*, 2018c], [Lieto *et al.*, 2018a], [Lieto *et al.*, 2018b], [Lieto, 2017]. In particular, I have proposed to adopt a hybrid representational and reasoning framework a la DUAL PECCS [Lieto *et al.*, 2017c] by showing how such cognitively inspired solution allows to deal with some of such knowledge-level problematic aspects [Chella *et al.*, 2017], [Lieto *et al.*, 2017a].

5 Semantic Technologies for Digital Humanities

In the last years, I have also approached the application of semantic web technologies and ontological modelling in the area of cultural heritage [Damiano *et al.*, 2014], [Egloff *et al.*, 2018], interactive storytelling [Damiano *et al.*, 2017], digital creativity [Damiano *et al.*, 2015] computational models of narrative [Lieto, 2015] and affective computing [Patti *et al.*, 2015]. This line of research has been carried out in different projects involving companies, cultural institutions and University.

6 Human Computer Interaction and Persuasive Technologies

Another area of interest is Human-Computer Interaction. In this area, I have worked in the field of persuasive technologies by analyzing the "non-logical" foundations of the forms of interaction occurring between human users and technological systems. The starting hypothesis of this research line is that some of the most common strategies adopted in persuasive technologies can be reduced to "para-logical" arguments based on logical fallacies. In particular, I have co-developed a persuasion matrix unveiling the direct correspondence between fallacious arguments (arguments that, even if not logically valid, are rational and cognitively persuasive) and some of the most common techniques used by the persuasive technologies [Lieto and Vernero, 2013]. Additional experiments have used such matrix to show an effective influence of fallacious-reducible techniques, adopted in web technologies, on human users [Lieto and Vernero, 2014].

7 Logic of Typicality for Conceptual Combination

This line of research is strictly related to the first one about ontologies and common-sense reasoning but it differs from the previous line of research for two reasons: first, it does not attempt to individuate a general, cognitively-inspired, knowledge architecture for common-sense reasoning but it attempts to provide a computationally efficient non monotonic extension of standard description logics. Second: the main focus here is on the specific problem of conceptual combination. In order to deal with the problem of common-sense concept combination I have co-developed a probabilistic non monotonic logic of typicality that, equipped with some cognitive heuristics coming from the field of cognitive semantics, allows to deal with both some well known cognitive phenomena (e.g. the pet fish problem and the Linda problem) [Lieto and Pozzato, 2020], [Lieto and Pozzato, 2018b] and with problems concerning, in a computational creativity scenario, the creative invention of novel concepts (e.g. for novel characters [Lieto and Pozzato, 2018a]). The logic has been implemented in tool called COCOS [Lieto *et al.*, 2018d] and tested in both cognitive [Chiodino *et al.*, 2020b] [Lieto *et al.*, 2019b] [Lieto *et al.*, 2019a] and industrial domains [Chiodino *et al.*, 2020a].

8 Computational Explanation

Finally, I have been recently become interested in the area today named "Explainable AI" (XAI) concerning the development of "transparent algorithmic procedures" that should be adopted to build artificial systems able to provide explanations about their exhibited behaviour. Preliminary research have been carried out on a robotic platform employing a dual strategy for explaining its behaviour [Augello *et al.*,] and on a vectorial system able to generate simple explanations about the similarity ratings generated for pairs of concepts [Colla *et al.*, 2018].

9 Conclusion

This document declines my main research areas and the outlines the main corresponding publications. It should be intended as a complement to my standard cv.

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