

# Special issue arising from the Third International Workshop on Computational Models of Scientific Reasoning and Applications

Claudio Delrieux and Luís Moniz Pereira, editors

This special issue of the Journal of Applied Logic contains a selection of the papers presented at the **Third International Workshop on Computational Models of Scientific Reasoning and Applications** (III CMSRA), which was held on 14–15 September 2003 in Buenos Aires, Argentina, chaired by Claudio Delrieux. The CMSRA workshop series has provided an annual forum for bringing together practitioners in several fields involved in the computational models of scientific reasoning (Logic, KR&R, Cognitive Sciences, Epistemology and Theory of Science, among others), in order to exchange the results of their ongoing research, share their experiences and speculate about their impact on the new information technologies. Of the 21 papers appearing in the proceedings, 11 were invited to participate in this issue with extended versions, for a second round of reviewing. Of those that accepted the invitation 6 were selected for publication.

The papers included here illustrate several trends that may be of interest to those working in the computational models of scientific reasoning, and provide a good sample of the different multidisciplinary approaches and interests, yet unified by the common aim of applying Science to study Science itself.

This volume starts with Pierangelo Dell’Acqua and Luís Moniz Pereira’s contribution *Common-sense reasoning as proto-scientific agent activity*. The authors model common-sense reasoning in situations where it contains some of the ingredients typical of proto-scientific reasoning. For this, the authors employ an integrative formal computational machinery for rational cooperative epistemic agents, where agents can update their own and each other’s theories, which are comprised of knowledge, active rules, integrity constraints, queries, abducibles, and preferences; they can engage in abductive reasoning involving updatable preferences; set each other queries; react to circumstances; plan and carry out actions; and revise their theories and preferences by means of concurrent updates on self and others. The application of proto-scientific reasoning in common-sense examples, modelled by collections of rational agents, is worth pursuing as a model of collaborative scientific theory development and refinement.

The second paper, *Abductive inference in defeasible reasoning: a model for research programmes*, by Claudio Delrieux, develops a formal treatment for em-

bedding abduction in defeasible theories, in particular, abduction for the explanation of *anomalous* observations, *i. e.*, observations that are contradictory with the current theory. The author discusses some issues arising the pragmatic acceptance of abductive inferences in defeasible theories, and how to accommodate anomalous observations and characterize all the possible outcomes that a defeasible theory may face when confronted with new evidence, and an application of the system as a formal device for representing the methodology of scientific research programmes. In this representation, a programme is regarded as a defeasible theory that draws predictions. When confronted with surprising or anomalous observations, the programme protects itself by means of *heuristic* procedures, which are represented as abductive inference procedures.

Lorenzo Magnani's contribution, *Reasoning through doing: epistemic mediators in scientific discovery* illustrates that some typical internal abductive processes are involved in *scientific reasoning* and *discovery* (for example through radical innovations). The author claims that even though recent epistemological and cognitive studies concentrate on the concept of *abduction* as a means to originate and refine new ideas, this "traditional" cognitive science and computational accounts concerning abduction aim to illustrate discovery and creativity processes only in terms of *theoretical* and "internal" aspects, by means of computational simulations and/or abstract cognitive models. Nevertheless, this work shows that specially concrete manipulations of the external world constitute a fundamental scientific procedure: by a process of *manipulative abduction* it is possible to build prostheses (*epistemic mediators*) for human minds, by interacting with external objects and representations in a constructive way. In this manner it is possible to create *implicit* knowledge through doing and to produce various opportunity to find, for example, anomalies and fruitful new risky perspectives. This kind of embodied and unexpressed knowledge holds a key role in the subsequent processes of scientific comprehension and discovery.

The fourth paper, *Measuring coherence using LP-models*, by Carlos Oller, introduces a technique for measuring the degree of (in)coherence of inconsistent sets of propositional formulas. The coherence of these sets of formulas is calculated using the minimal models of those sets in G. Priest's *Logic of Paradox*. The compatibility of the information expressed by a set of formulas with the background or domain knowledge can also be measured with this technique. The author then addresses some objections against many-valued paraconsistent logics as instruments for measuring (in)coherence. This work shows, among other things, that a system of paraconsistent logic can have a rôle that goes beyond the task of identifying valid forms of inference, and can be used as a tool for analyzing the information contained in (possibly inconsistent) sets of formulas.

The following contribution, *Semantic computations of truth based on associations already learned*, by Patrick Suppes and Jean-Yves Béziau, is aimed to describe the computations with the mental images of words and other things underlying human common-sense and everyday reasoning, taking in account in particular the time factor. This theory should be able to explain the data gathered by experimentation, for example why it takes more time to give a negative

answer (with false or/and with not) than a positive one, be it true or false. The general mechanism leading to a false or to a true reply should be the same, since there seems to have no differences in nature in the computation of the result. The authors claim that Philosophical work on theories of truth (coherence theory, correspondence theory, etc.), problems of direct reference, sense and denotation and so on, curiously are not able to give an account of how humans perform truth statements, and even less why humans are able to perform them so quickly. The key of these abilities, Suppes and Béziau claim, is based on the use of associations, also called “semantics networks” or “associative networks” in AI.

This volume is closed by Gregory Wheeler and Luís Moniz Pereira’s contribution *Epistemology and Artificial Intelligence*. Despite the generality of the title, it is focused at a very specific claim: the idea of seeing epistemology and AI as complementary ways of approaching the same set of issues. The authors show how AI and epistemology in the end study the very same epistemic relations. Artificial Intelligence approaches the subject from the perspective of understanding formal and computational properties of frameworks, while epistemology does it from the perspective of understanding the properties of epistemic relations in terms of their conceptual properties. To illustrate their point, the authors develop a formal representation of a class of non-monotonic inference forms found at the heart of standard inferential statistics using a variation of default logic, called statistical default logic. They discuss some semantics for default theories and logic programs, enough to give a sketch of how the correspondence results are obtained. This example is structurally analogous to an important class of relations that arise in contemporary theories of knowledge. The authors therefore argue that practice in epistemology and in AI should not be conducted in isolation. As can be seen from the success of the ongoing CMSRA workshop these years, there is a growing community that strongly agrees with that claim.

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