
Preface: Special issue on logic and argumentation

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1 Introduction to the special issue

This special issue of the *Journal of Logic and Computation* contains a selection of contributions presented at the *5th International Conference on Logic and Argumentation* (CLAR 2023), held in Hangzhou (China), September 10–12, 2024 [9]. The *International Conference on Logic and Argumentation* (CLAR) is a series of (roughly) biennial conferences that highlight recent advances in the two fields of logic and argumentation.¹ The CLAR series aims at bringing together researchers from various disciplines such as logic, formal argumentation, artificial intelligence, philosophy, computer science, linguistics and law. Research in logic and argumentation offers formal or semi-formal models that capture reasoning patterns and dialogues of diverse kinds. Their applications in artificial intelligence range from law and ethics to linguistics.

The authors of a selection of papers presented at CLAR 2023 were invited to submit expanded and revised versions of their work to this Special Issue. Submission and reviewing were handled through the EasyChair platform. As two of the co-editors are authors of submissions to the special issue, it was decided among the guest editors that the third co-editor (A. Herzig) would be the only one to have access in the EasyChair 'program chair' role in order to guarantee full anonymity in the reviewer process. All submissions were carefully reviewed (single-blind) by members of the CLAR program committee, as well as by additional external reviewers. After a careful evaluation of each submission by at least two reviewers, four full articles were accepted and are included in the present issue. The topics of the accepted contributions include *automated theorem proving* (translations of quantified modal logic to higher-order logics) *structured argumentation* (axiomatic approaches to attack relations); *justification and modal logics* (explanations in dialogues); and *quantitative*

¹Previous editions took place in the years: 2016 (Hangzhou), 2018 (Hangzhou) and, following the (post-)pandemic situation, 2019 (online) and 2021 (hybrid). The fifth edition CLAR 2023 was held together with several closely related events: the 3rd International Workshop on Logics for New-Generation Artificial Intelligence (LNGAI 2023), the International Workshop on Logic, AI and Law (LAIL 2023), and the workshop Epistemology & AI. The next edition of CLAR (2025) is expected to take place in Taiyuan (China).

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argumentation (fuzzy labelling semantics). These contributions reflect well on major topics in the state of the art of research in logic and argumentation.

The article ‘Solving Quantified Modal Logic Problems by Translation to Classical Logics’ by Alexander Steen, Geoff Sutcliffe and Christoph Benzmüller evaluates different automated theorem proving systems for quantified modal logics (QML) using the QMLTP benchmark, a collection of formulas each involving one or more modalities. The five modal logics K, D, T, S4 and S5 are considered. For each of them theorem proving is studied under constant, increasing and varying domains, resulting in 15 configurations in total. The systems compared include, on the one hand, translations to typed first- and higher-order logic [2, 3] (using shallow embeddings) and the corresponding (dis)provers, and, on the other hand, two ‘native’ QML provers [11, 12]. Between the two approaches, the authors suggest, the best performance depends on the particular configuration, although overall embedding approaches seem to perform better. A similar conclusion holds for the task of disproving conjectures, with higher-order provers being more effective. Finally, the embedding approach handles a wider range of modal logics than the native QML provers.

In ‘Weakest Link, Prioritised Default Logic and Principles in Argumentation’, Pere Pardo, Liuwen Yu, Chen Chen and Leendert van der Torre study axioms for a variety of attack relations inspired by Weakest Link or some closely related Default Logics, following a recent axiomatic approach for Last Link due to Dung and Thang [7, 8]. The idea of Weakest Link is that the strength of a logical argument is the strength of its weakest component (a default rule), while the idea of Last Link is that the strength of a logical argument is the strength of its last component. Each of these two lifting principles assigns a measure of strength to the arguments generated by a knowledge base, thereby inducing a relation of attack between arguments. Upon this relation, an argumentation semantics determines which arguments and conclusions are accepted. Axiomatic approaches, then, aim to recast the debate between Weakest and Last Link in terms of the intuitive character of these axioms. In addition to the study of Dung’s axioms [7] for variants of Weakest Link, this article proves an impossibility theorem for these axioms w.r.t. PDL logic of [4], compares the set extensions of argumentation- and logic-based methods, and explains their historical importance through key examples.

In ‘Tailoring Explanations Through Conversation’, Jieting Luo, Thomas Studer and Mehdi Dastani introduce a justification logic designed for an explainer to offer personalized explanations to an explainee through a series of conversations. The increasing applications of AI systems require personalized explanations for their behaviors to various stakeholders since the stakeholders may have various backgrounds. Hilton argues that an explanation is a *social* process of conveying why a claim is made to someone [10]. The conversations between explainers and explainees allow explainers to obtain explainees’ background, enabling explainers to tailor their explanations so that explainees can better understand the explanations. In order to model the conversation, they see that an agent understands an explanation if the agent is able to justify all parts of it, which is similar to the logic of knowing why [5]. With this idea, an explainer can interpret the explainee’s background from her feedback regarding whether she understands the explanation that has just been received, and provide further explanations given what she has learned about the explainee. Among the formal results, the authors prove that the conversation terminates once the explainee justifies the initial claim, provided there is an explanation for that claim that the explainee comprehends and that the explainer knows about.

The article ‘Fuzzy Labeling Semantics for Quantitative Argumentation’ by Zongshun Wang and Yuping Shen presents a fuzzy labelling approach to fuzzy argumentation systems. Arguments B and pairs of arguments (attacks) are assigned quantitative strengths, whose minimum defines the attack intensity of a particular attack (B, A) . As a generalization of Dung’s admissibility semantics [6],

these attacks are classified into tolerable (if <1) and sufficient (if ≥ 1). The labelling function then assigns each argument (within a given argumentation framework) a triple of degrees of acceptability, rejectability and undecidability. Fuzzy labelling merges gradual and labelling semantics with these numerical values on labels. For the proposed class of fuzzy labelling semantics, the authors first adapt criteria from classical labelling semantics [1] and investigate postulates for fuzzy labelling; secondly, they formalize fuzzy labelling semantics that satisfy these postulates and examine their properties; finally, the authors prove that fuzzy labelling semantics can be seen as both as a conservative extension of classical labelling semantics, and as a labelling counterpart of the fuzzy extension semantics in the literature [13].

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