EDITORIAL

Guest Editorial Argumentation-Based Reasoning

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Real-world knowledge-based systems must deal with information coming from different sources, leading to uncertainty due to incompleteness, inconsistency, and/or inherent uncertainty (such as the uncertainty present in very complex systems such as the stock market or the weather). Instead of considering such uncertain information to be useless, knowledge engineers face the challenge of putting it to good use when solving a wide range of problems. *Argumentation* is a useful approach in this setting: Reasons for and against a claim are analyzed to decide on an outcome, much in the same way as organized human discussions are carried out.[1–5] An important byproduct of such analyses is an accompanying explanation that can be leveraged to decide if there is information that should be used differently, discarded, or there is further information to be contemplated.

Since there has recently been increasing demand for explainability of intelligent systems that operate in certain domains that have high-impact consequences, such as medical or legal decisions, argumentation-based approaches are ideal for query answering and reasoning systems that contemplate human-in-the-loop models to tackle the challenges of incompleteness and inconsistency in data. Motivated by this, we organized the present Special Issue in *IEEE Intelligent Systems* to solicit the latest advancements in this topic.

In total, we received 15 valid submissions that were evaluated by knowledgeable reviewers in the field. In the following, we provide a brief introduction to the nine accepted papers, which can be broadly grouped into three categories: 1) *Abstract Argumentation*, 2) *Structured Argumentation*, and 3) *Systems and Methodologies*.

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ABSTRACT ARGUMENTATION

Abstract frameworks focus on encoding the relationships between arguments, which, in general, can be of several different kinds, giving rise to graph structures—in particular, arguments themselves are atomic units, represented as nodes in a graph.[4,6] The importance of this approach lies in the need to establish principled semantics for conflict resolution; having a structure that abstracts away the details often helps in making initial progress in this task.

In "Incremental Skeptical Preferred Acceptance in Dynamic Argumentation Frameworks,"[7] Alfano and Greco discuss an incremental technique for efficiently recomputing the acceptance status of a goal argument in an argumentation framework. The proposed approach uses the information concerning the initial acceptance status of arguments and the update in order to identify a potentially small portion of the framework that is of interest for recomputing skeptical acceptance under preferred semantics.

The other paper in this group is also related to the computational cost of basic problems. "Complexity of Nonempty Existence Problems in Incomplete Argumentation Frameworks,"[8] by Skiba *et al.*, presents a detailed complexity analysis of problems concerning nonempty existence of extensions for incomplete argumentation frameworks, where the basic model is extended by allowing for the representation of unquantified uncertainty about the existence of elements in an argumentation framework.

STRUCTURED ARGUMENTATION

On the other hand, structured argumentation refers to approaches that provide access to the building blocks—facts, presumptions, and different kinds of rules—used to actually come up with arguments. This added level of detail enables different kinds of analyses compared to abstract approaches, and is, thus, often necessarily

centered on concrete frameworks, such as Assumption-Based Argumentation (ABA),[9,†] Argumentation Service Platform with Integrated Components (ASPIC$^+$),[10,‡] and Defeasible Logic Programming (DeLP).[11,§]

In "A Basic Framework for Explanations in Argumentation,"[12] Borg and Bex introduce a flexible and generic framework for explanations in both structured and abstract argumentation. Specialized local explanations for the (non)acceptance of arguments can be given, taking into account credulous and skeptical reasoners. Different types of explanations can be captured in the framework and a real-life application is discussed.

Next, in "Using Argumentation to Obtain and Explain Results in a Decision Support System,"[13] Buron Brarda *et al.* develop an approach for multicriteria argumentation-based decision support leveraging user-provided conditional preference statements. The authors also tackle the problem of providing explanations to how the system arrives at conclusions, applying a semantics that is based on the construction and analysis of dialectical trees, in the style of DeLP.

In the last article, entitled "An Architecture for Argumentation-Based Epistemic Planning: A First Approach With Contextual Preferences,"[14] Teze and Godo study argumentation-based planning, in which plans are built with additional information available in a knowledge base, enabling the consideration of rich domain knowledge and dynamically changing preferences, among other capabilities. The authors introduce a general argumentation-based planning architecture that serves as a guide in the analysis and design tasks that need to be carried out as a part of software engineering efforts in this arena.

SYSTEMS AND METHODOLOGIES

This last group of papers centers on developing application-specific systems and methodologies leveraging either abstract or structured argumentation.

The first paper is entitled "An Optimized Quantitative Argumentation Debate Model for Fraud Detection in E-commerce Transactions,"[15] by Chi *et al.* The authors tackle the lack of explainability and interpretability of machine-learning-based approaches to fraud detection in online transactions by analyzing arguments that combine data and knowledge, as well as correlations among them.

Next, in "Applying Metalevel Argumentation Frameworks to Support Medical Decision Making,"[16] Kokciyan *et al.* propose a metalevel argumentation-based decision-support system that can reason with heterogeneous data (e.g., static data coming from clinical guidelines or dynamic data provided by sensors) while incorporating user preferences as a part of the reasoning process. The system provides semistructured textual explanations for the recommendations that it makes.

Third, Lindgren *et al.* present a design methodology for argumentation-based health information systems in "Argumentation-Based Health Information Systems: A Design Methodology."[17] Their methodology aims at eliciting requirements regarding argumentation-based reasoning behavior, knowledge, and user models, as well as business logic at levels both above and below the argumentation layer.

The last article in this segment, entitled "Fact Investigation and Proof Standards in Legal Argumentation" by Moguillansky,[18] proposes a logical framework to model legal interpretation and bring about an appropriate construction of legal arguments. The proposal aims at developing the theoretical foundations for implementing intelligent systems capable of assisting the reasoning activity of judges, by recognizing—and making them aware in advance—whenever a biased decision is about to be made.

Finally, we would like to express our sincere appreciation to the Editor-in-Chief, Prof. V. S. Subrahmanian, the journal's administrative team, and the authors for their support in making this special issue possible. Special thanks also goes out to the reviewers for their constructive and timely feedback, which was fundamental to the process of creating a high-quality issue.

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