Computational Models of Argument
F. Toni et al. (Eds.)

doi:10.3233/FAIA220136

Argumentation: From Theory to Practice & Back

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Keywords. Machine Argumentation, Applied Argumentation, Cognitive Argumentation

Machine and Human Argumentation differ in many respects. Yet, to have useful and effective applications of argumentation in AI these two forms of argumentation need to come close so that we have a natural form of interaction between humans and machines. This closeness or compatibility between machine and human argumentation is needed not only at the level of the form of communication but also at the internal operational level of the argumentation process. For example, the capability of an argumentative dialogue by an argumentation-based system and the usefulness of the explanations it offers would be enhanced when there is a deeper form of compatibility between the argumentative reasoning processes of these systems with that of human reasoning.

In order for real-life applications of argumentation based systems to achieve such a high-degree of natural compatibility while operating in an external dynamic environment that includes the "human in the loop", we need to address two **major challenges**:

- **Acquisition of Application Knowledge** What is an appropriate language level that would facilitate capturing the application knowledge either from the application expert and/or the application data? What is the appropriate cognitive-level of this language? Can this be (structured) Natural Language?
- **Middleware from Sensory Information to High-level Application Concepts** What are effective ways of comprehending the relevant part of the current application environment? How do we recognize the current state of affairs and the particular decision context in which the system finds itself?

To address these challenges we need software methodologies that facilitate the development of systems directly from the high-level application domain language, data and expertise. One such methodology is *SoDA* which together with the systems of *Gorgias* and *GorgiasCloud* offers Explainable Argumentation as a Service for online applications. Recently, these technologies have formed the basis for a start up company called **Argument Theory** in Paris which offers solutions to real-life application decision taking problems based on argumentation technology. Its first successful application concerns automated help in the annotation of documents for blind readers, while currently it is developing prototype systems for applications in the areas of medical decision support, personal assistants and policy compliance.

Such applications emphasize the need for a human-like form of machine argumentation. To help us address this we can study the synthesis of cognitive principles within formal computational frameworks of argumentation. Cognitive principles are drawn from

our understanding of human reasoning as acquired across a wide range of disciplines, such as Cognitive Science, Philosophy and Linguistics. They would inform and regulate the computational process of argumentation to be cognitively compatible to human argumentation and reasoning. **Cognitive Argumentation** concerns such a study which together with its *COGNICA* system for explainable conditional reasoning, offers the opportunity for carrying out large scale empirical studies of human-machine reasoning interaction. For example, *COGNICA* is used to study the effect that machine explanations can have on humans when reasoning or deciding what action to pursue.