Tuorial: Depth-Bounded Reasoning and Formal Argumentation

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Logic started with Aristotle as an attempt to provide a prescriptive formal theory of human reasoning. Starting from the end of the XIX century, as a result of its interaction with mathematics and computer science, the original motivation was largely lost — with the only notable exception of Gentzen-style natural deduction methods — to re-emerge in the last few decades as a result of the growing interest for human-oriented computing (HOC) and in connection with the new field of cognitive science. However, at present, both HOC and cognitive science can hardly benefit from the formal models that have been developed within the paradigms of mathematical and computational logic. There are essentially three major problems:

Problem 1. Logicians have so far focused on giving a normative characterization of consequence relations that comply with some notion of deductive inference (e.g., as one that transmits truth from the premises to the conclusion), but their models are not scalable: they can reflect only the logical competence of *ideal* agents with *unlimited resources* and, therefore, fail to have any explanatory or prescriptive value for real-world resource-bounded agents. This is known as the problem of *logical omniscience*.

Problem 2. The rational behaviour of real agents is very seldom the result of a deductive process starting from universally accepted axioms or normative principles. Typically, it is the result of a "dialectic" process in which an argument A in support of a certain thesis can be attacked by a counter-arguments B that attempts to undermine some of the premisses on which A is based. However, A can be defended from such attacks by means of other arguments that attack B on one of its premisses, and so on. Under certain conditions certain sets S of arguments may emerge, at a given stage of the argumentation process, as (provisionally) successful — and their conclusions as (provisionally) justified. On the other hand, mathematical logic is inspired by the notion of proof in an axiomatized theory and is therefore far removed from real argumentation practice.

In this tutorial I will briefly review these three problems and provide the basic background notions that are necessary to address the growing scientific literature on the subject or resource-bounded reasoning and formal argumentation. The students will be involved in practical tasks concerning the construction of logical arguments and counterarguments in a multi-agent environment with bounded resources.