Argument Structure Models and Visualization

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INTRODUCTION

In order to visualize argumentation, there exist tools from multimedia. The most advanced sides of computational modeling of arguments belong in models and tools upstream of visualization tools: the latter are an interface. Computer models of argumentation come in three categories: logic-based (highly theoretical), probablistic, and pragmatic *ad hoc* treatments. Theoretical formalisms of argumentation were developed by logicists within artificial intelligence (and were implemented and often can be reused outside the original applications), or then the formalisms are rooted in philosophers' work. We cite some such work, but focus on tools that support argumentation *visually*.

Argumentation turns out in a wide spectrum of everyday life situations, including professional ones. Computational models of argumentation have found application in *tutoring systems,* tools for *marshalling legal evidence,* and models of *multiagent communication. Intelligent systems* and other computer tools potentially stand to benefit as well.

Multimedia are applied to argumentation (in *visualization tools*), and also are a promising field of application (in *tutoring systems*). The design of *networks* could potentially benefit, if communication is modeled using *multiagent* technology.

TOOLS FOR VISUALIZING THE STRUCTURE OF ARGUMENTS

An application of multimedia is tools for displaying in two dimensions a graph that represents the construction or conflict of arguments. The convenience of displaying the structure of arguments visually has prompted the development of tools with that task; for example, Carr (2003) described the use of a computer tool, *QuestMap* (Conklin & Begeman, 1988), for visualizing arguments, for use in teaching legal argumentation. Reed and Rowe (2001) described an argument visualization system called *Araucaria.* Prakken, Reed, and Walton (2003), on legal evidence, apply *Araucaria* to an analysis in the style of Wigmore Charts: two sections below deal with these. Verheij (1999) described the *ArguMed* computer tool for visualizing arguments; Loui et al. (1997), a tool called *Room 5*. Van den Braak, van Oostendorp, Prakken, and Vreeswijk (2006) compare the performance of several such argument visualization tools.

BACKGROUND CONCEPTS: KINDS AND LEVELS OF ARGUMENTATION

Argumentation is the activity of putting arguments for or against something. [...] In purely speculative matters, one adduces arguments for or against believing something about what is the case. In practical contexts, one adduces arguments which are either reasons for or against doing something, or reasons for or against holding an opinion about what ought to be or may be or can be done (MacCormick, 1995, pp. 467-468).

A reason given for acting or not acting in a certain way may be on account of what so acting or not acting will bring about. Such is teleological reasoning. All teleological reasoning presupposes some evaluation (MacCormick, 1995, p. 468).

In contrast, "Deontological reasoning appeals to principles of right or wrong [...] taken to be ultimate, not derived from some form of teleological reasoning" (MacCormick, 1995, p. 468). Systemic arguments are kinds of "arguments which work towards an acceptable understanding of a legal text seen particularly in its context as part of a legal system" (p. 473), for example, the argument from precedent, the argument from analogy, and so forth.

Prakken and Sartor (2002, Section 1.2) usefully

propose that models of legal argument can be described in terms of four layers. The first, logical *layer defines what arguments are, [that is], how pieces of information can be combined to provide basic sup-*

port for a claim. The second, dialectical *layer focuses on conflicting arguments: it introduces such notions as "counterargument," "attack," "rebuttal," and "defeat," and it defines, given a set of arguments and evaluation criteria, which arguments prevail. The third,* procedural *layer regulates how an actual dispute can be conducted, [that is], how parties can introduce or challenge new information and state new arguments. In other words, this level defines the possible speech acts, and the discourse rules governing them. Thus the procedural layer differs from the first two in one crucial respect. While those layers assume a fixed set of premises, at the procedural layer the set of premises is constructed dynamically, during a debate. This also holds for the final layer, the* strategic *or* heuristic *one, which provides rational ways of conducting a dispute within the procedural bounds of the third layer.*

A CONTEXT FOR ARGUMENTATION AND FORMALISM

Argumentation is a field of rhetoric (there exists a journal titled *Argumentation*), which finds massive application, for example, in law and in negotiation, which is reflected in computer tools subserving these (Zeleznikow, 2002). Within artificial intelligence (AI), argumentation has been conspicuous in the mainstream of AI & Law (i.e., AI as applied to law). After 2000, it was applied also in AI modeling of reasoning on legal evidence. Also AI tools for supporting negotiation (legal or otherwise) use argumentation. Yet, as early as Thagard (1989), the neural-network-based tool ECHO would apply abductive reasoning (i.e., inference to the "best" explanation) in order to evaluate items, either evidence or inferred propositions, while simulating the reasoning of a jury in a criminal case. Poole (2002) applied to legal argumentation about evidence, a formalism called independent choice logic (ICL), which can be viewed as a "first-grade representation of Bayesian belief networks with conditional probability tables represented as first-order rules, or as a [sic] abductive/argument-based logic with probabilities over assumables" (p. 385).

In the *theory of anchored narratives* of Wagenaar, van Koppen, and Crombag (1993), narrative (e.g., the prosecution's claim that John murdered his wife) is related to evidence (e.g., John's fingerprints on the murder weapon) by a connection, an *anchor:* for the story to be comprehensively anchored, each individual piece of evidence need be not merely plausible, but safely assumed to be certain, based on common-sense rules that are probably true. That theory was discussed by Verheij (1999) in the context of a work on dialectical argumentation for courtroom (judicial) decision-making.

Concerning anchoring by common-sense beliefs, this is referred to by other authors on legal evidence as empirical generalizations. Twining (1999) is concerned with generalizations in legal narratives. See also Anderson (1999b). Bex, Prakken, Reed, and Walton (2003, Section 4.2) discuss such generalizations in the context of a formal computational approach to legal argumentation about a criminal case, and so does Prakken (2004, Section 4). The latter (Section 4.2) lists four manners of attacking generalizations: "Attacking that they are from a valid source of generalizations," "Attacking the defeasible derivation from the source" (e.g., arguing that a given proposition is general knowledge indeed, but that "this particular piece of general knowledge is infected by folk belief"), "Attacking application of the generalization in the given circumstances" ("This can be modeled as the application of applying more specific generalizations"), and "Attacking the generalization itself."

WIGMORE OR TOULMIN? THE REPRESENTATION OF ARGUMENTS IN CHARTS

John Henry Wigmore (1863-1943) was a very prominent exponent of legal evidence theory (and of comparative law) in the United States. A particular tool for structuring argumentation graphically, called Wigmore Charts and first proposed by Wigmore, has been in existence for the best part of the 20th century, and was resurrected in the 1980s. Wigmore Charts are a handy tool for organizing a legal argument, or, for that matter, any argument. They are especially suited for organizing an argument based on a narrative. Among legal scholars, Wigmore Charts had been "revived" in Anderson and Twining (1991); already in 1984, a preliminary circulation draft of that book was in existence; it includes (to say it with the blurb) "text, materials and exercises based upon Wigmore's *Science of Judicial Proof"* (i.e., Wigmore, 1937). Anderson (1999a) discusses an example, making use of a reduced set of symbols from his modified version of Wigmore's original chart method.