Chapter 13
AI and Law

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13.1 The Domain of AI and Law

Few disciplines may appear to be as far apart as law and artificial intelligence. The first can vaunt a tradition spanning millennia, while the second cannot go beyond 1950. The first is a cultural discipline, deeply enmeshed in the fabric of human life, while the second is a technological science, dealing with hardware and software artifacts. The first is usually conceived as a form of art (the art of the good and the right) which cannot be reduced to predetermined mechanical procedures, while the second focuses precisely on the problem of mechanisation. Besides those differences, however, there are also important points of convergence: both disciplines need to approach the complexities of the human mind and human action, both need to use and organise large quantities of information, both want to engage in flexible problem-solving activities in complex domains.

The combination of this challenging distance and this promising convergence between AI and law explains the reciprocal attraction between those disciplines, which has led to the establishment of an active research community and to the achievement of significant theoretical results as well as bearing fruit in many computer implementations. AI and Law research and results cover many different topics, such as

- Formal theories of norms and normative systems,
- Computational legal logic,

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- Legal argumentation systems,
- Ontologies for the law,
- Game theory as applied to the law,
- Formal models of legal institutions and MAS,
- Simulations in legal and social norms,
- Rule-interchange languages for the legal domain,
- Legal e-discovery and information retrieval,
- NLP in the legal domain,
- Machine learning in the law.

Many AI researchers considered that the development of AI applications in the legal domain should make use, not only of legal sources, but should also interface with legal theory, legal doctrine, and philosophy. In this sense, AI and Law is indeed an interdisciplinary effort, combining methods and results also from deontic logic, norms and agent-based simulation, game theory and norms, normative agents, norms and organization, norms and trust, and norms and argumentation. In the remainder, we will shortly illustrate AI and Law research by revolving around some general key ideas in regard to how the law can be viewed from that research perspectives. The following outline should by no means be considered exhaustive and just considers some well-established research areas.

13.2 Law as a Deductive System or a Set of Rules

The first attempts to apply computational models to the law were inspired by the idea of the law as a deductive system, namely as a set of premises from which legal conclusions could be achieved through deductive inferences, a view that was inspired, e.g., by Allen (1957), Alchourrón and Bulygin (1971), Yoshino (1978) and Allen and Saxon (1991). Thus, according to this approach, given a set L of legal premises (a set of legal rules) and a set F of facts, through logical deduction (including predicate logic and possibly a deontic logic), one would achieve relevant legal consequences, namely, any (relevant) proposition p such that $L \cup F \vdash p$. This idea was implemented in knowledge-based systems. Over the last few years some systems have been developed and commercialised which correspond to these idea. In particular, I would mention the most successful of them, originally named Softlaw and developed in Australia by Peter Johnson, then managed as Ruleburst under the leadership of Surend Dayal and finally become Oracle's Policy automation system. This is a commercial product, which includes a set of tools for building knowledge-bases of regulations, for checking their correctness and consistency and for using them interactively.

A fundamental development of rule-based systems for the law has been investigating the connection with AI research on non-monotonic reasoning. In fact it appeared that various aspects of the law, such as the interaction between rules and exceptions, conflicts between norms, presumptions, temporal reasoning, the

dynamics of legal systems, burdens of proof could at least partially be addressed through non-monotonic reasoning. This was starting with using Prolog and in particular negation by failure to model legal norms. Negation as failure can indeed be used to express that a rule is to be applied only as long as a negated element in the rule's antecedent cannot be derived from the knowledge base.

The seminal paper by Sergot et al. (1986) stimulated numerous attempts to use logic programming to build knowledge-based systems, as well as further theoretical inquiries into the use of logic programming for modelling legal reasoning and knowledge (McCarty 1988a,b). Modeling the law as a set of defeasible rules is thus a key idea in the AI and Law community: a recent overview of requirements for developing rule-based systems in the law can be found in Gordon et al. (2009). In fact, one may argue that legal reasoning is part of human cognition, which is defeasible (Pollock 1995a) or that is developed within argumentative settings where arguments and counter-arguments dialectically interact.

13.3 Law as an Argumentation Framework

Among the various approaches to non-monotonic reasoning, defeasible argumentation has been the most successful in the legal domain (see Chap. 16). Following this idea, the law L, in combination with facts F, appears as a multifaceted argumentation framework (including rules, assumptions, preferences, alternative interpretations, exclusions, values), from which multiple arguments can be constructed. What consequences follow (credulously or sceptically) from that argumentation framework depends on which arguments succeed in sustaining attacks over other arguments, so that such arguments (and their consequences) may be viewed as justified or at least defensible. While relying on general models of argument-based defeasible reasoning (such as Pollock (1995b) and Dung (1995)) researchers in AI and law have developed original models of defeasible argumentation (Bench-Capon and Prakken 2006; Dung and Thang 2008; Gordon 1995; Hage 1997; Prakken and Sartor 1996; Verheij 2003). A legal argumentation framework usually contains a logical layer, a dialectical layer, and a procedural layer of legal arguments: the first deals with the underlying formal language that is used to build legal arguments; the second studies when legal arguments conflict, how they can be compared and what legal arguments and conclusions can be justified; the third one considers the ways through which conclusions are dynamically reached in legal disputes.

The idea of the law as an argumentation framework has recently been enriched with the idea of argument schemes, an idea developed in particular by Douglas Walton (2005), Walton et al. (2008), Gordon et al. (2007) and Gordon and Walton (2009), though it can also be linked to Pollock (1995a). According to this idea rather than using in legal arguments a single kind of inference (defeasible rule-application) one would use multiple kind of inference schemes (witness testimony, expert testimony, practical syllogism, etc.), each one with its associated defeaters

(or critical questions). This approach has being adopted in some argument graphing tools such as Araucaria (Reed and Rowe 2007), and more recently in the Carneades system (Gordon and Walton 2009).

A different development of work in legal argumentation consists in the development of dialogue systems. The focus here is the *process* of argumentation, rather than the analysis of the implications of a set of arguments (or a knowledge base offering material for a set of arguments). Thus arguments are seen as the content of speech acts by the agents taking part in an interaction, according to a certain protocol, i.e., a set of rules governing the allowed moves and their effects. Which arguments are successful crucially depends on the protocol, that establishes which arguments are admissible, at any stage of the dialectical interaction, and what impacts they have on its prosecution (Gordon 1995; Lodder 1999; Prakken 2001; Riveret et al. 2007; Verheij 2003; Walton and Krabbe 1995). Research on argumentation frameworks and on dialogue protocols can be integrated, since the impact of an argument on the state of the dialogue crucially depends on whether it sustains the attacks of previous or subsequent arguments (Prakken 2010).

13.4 Law as a Case-Based-Reasoning System

Legal argumentation frameworks can be developed on top of an underlying formal language, which is used to build arguments. Many formal methods for reasoning can be used for this purpose, among which legal case-based reasoning has been particularly investigated within the AI and Law community (Ashley 1990; Ashley and Rissland 1988; Branting 1994; Horty 1999; Prakken and Sartor 1998a). A key idea behind case-based reasoning in the law is to model reasoning about precedents: this is done by devising methods for generalizing from past cases in order to trace legal solutions for a current case or to evaluate such a case by comparing it to precedents. An important aspect of this research effort has been thus to embed legal case-based reasoning within argumentation frameworks, and so in terms of argument-based defeasible logics (Loui and Norman 1995; Loui et al. 1993; Prakken and Sartor 1998b).

In particular, significant works have attempted to reconstruct legal case-based reasoning in terms of theory-based defeasible reasoning, i.e., in systems where the evaluation and the choice of theories are introduced to explain and systematize the available legal input information (typically, a set of precedents): when a better theory becomes available, inferior theories are to be abandoned (Bench-Capon and Sartor 2003; Sartor 2002). The idea is that the parties in a case, given a shared legal background of past cases, develop alternative legal theories, and victory goes to the party who develops the better theory. This leads to the idea that legal debates consist in the dialectical exchange of competing theories, supporting opposed legal conclusions in the issue at stake. Theories can be compared according to different criteria, such as case-coverage (a better theory explains more precedents), factor-coverage (a better theory takes into account more features of those precedents),

value-coverage (a better theory takes into account a larger set of values), analogical connectivity (a better theory includes more analogical connections between its components), non-arbitrariness (a better theory contains fewer ad-hoc statements, required neither for explaining the past evidence nor for implementing the shared assessment of value-priorities).

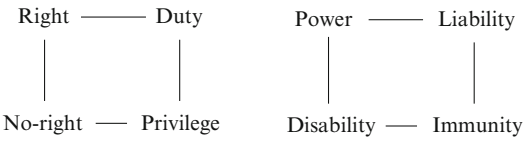
13.5 Law as a Set of Concepts: Legal Ontologies

Concepts play a key role in the law. Legal rules form a network where a legal effect (e.g., one's liability for violation of copyright) depends of qualifying a certain fact according to concepts provided by further rules (was there a violation of copyright, was there a damage?), which in its turn may depend on further facts (was there a protected work, was there an illegal use of it?), and so on. Moreover, the application of the law requires linking legal concepts to the common-sense and technical terms that are used to model the reality to which legal norms have to be applied.

Since the beginning of legal informatics, dictionaries and thesauri for the law have been developed. Researchers in AI and Law have been trying to provide a formal account of legal concepts and their relationships by using AI models for knowledge representation, from semantic networks, to frames, to ontologies (Breuker et al. 1997; Gangemi et al. 2005). In the framework of the semantic web the application of ontologies has been most studied (for a review, see Sartor et al. 2011).

13.6 Law as a Set of Deontic Concepts

The AI and Law research has also developed an interesting work at the interface of law and deontic logic (Allen and Saxon 1991; Hage 2011; Horty 2001; McCarty 1986; Sartor 2006) (see also Chap. 10). Besides importing well-known results from the deontic logic community, AI and Law scholars have for instance investigated Hohfeldian (1911) legal concepts, which correspond to typical effects of the application of legal norms, and of which these are the two main examples:



Right and duty are correlatives: if i (the bearer) has a right against j (the counterparty) that ϕ is brought about, then j has the obligation toward i to bring about ϕ. A privilege is the opposite of an obligation, e.g., j is not obliged toward i to bring about ϕ. Similarly no-right is the opposite of right and the correlative

of privilege. These concepts are captured by the so-called *directed obligations*, i.e. obligations where bearers and counterparties are made explicit in a designed deontic logic (Herrestad and Krogh 1995).

A formal analysis of the second square appeared more problematic. Such an analysis was programmatically set by Jones and Sergot in 1996, a paper aiming at modeling the notion of institutionalized power. After then, this analysis has been applied and further developed within the AI and Law community (Gelati et al. 2004).

13.7 Further AI and Law Approaches to the Law

In the above sections we have presented what we view as mature and well-established approaches to modelling norms and normative reasoning developed within the AI and Law community. These approaches are not exhaustive of the applications of AI ideas to the law. Leaving aside the many uses of advanced techniques to the retrieval of legal texts (which fall beyond the scope of the present review) we need to mention in particular the use of neural networks and the development of hybrid approaches. In application of neural networks to the law, the basic model has consisted of identifying the factors which could influence a certain kind of decision, and then connecting those factors (as input nodes) to possible decisions (as output nodes), via one or more layers of intermediate nodes. The network is then trained with real and hypothetical cases until it provides the correct answers (Bench-Capon 1993; Bochereau et al. 1999; Philipps and Sartor 1999; Zeleznikow and Stranieri 1995). The application of neural networks to model legal decision-making has been subject to some criticisms, focusing in particular on the lack of explanations, which makes the use of networks very questionable in legal contexts. Connectionist approaches have also been considered for different purposes, e.g., measuring coherence in legal theories (Bench-Capon and Sartor 2001).

Finally, we need to mention approaches that address two or more of the above mentioned aspects of the law, in an integrated or hybrid way. So we had systems integrating cases and rules (Gardner 1987; Rissland and Skalak 1993), rules and neural networks (Zeleznikow and Stranieri 1995), rules and value-based teleological reasoning (Bench-Capon and Sartor 2000; Chorley and Bench-Capon 2003).

Agent-based models of normative behaviour also integrate different aspects of the law: rules, goals, normative positions, relationships and institutions as well as norm-based reasoning, attitudes, and behaviours. The objective may be studying human behaviour through simulation, or to provide infrastructures where artificial and/or human agents can interact (see Chap. 11). Norm-governed agent-based systems have mainly been studied within the agent-based community, but some proposals have also been developed in AI and Law (Artikis et al. 2002, 2003; Sartor et al. 2009).

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