Chapter XXI
Emergent Reasoning Structures in Law

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ABSTRACT

In modern legal systems, a large number of autonomous agents can achieve reasonably fair and accurate decisions in tens of thousands of legal cases. In many of those cases, the issues are complicated, the evidence is extensive, and the reasoning is complex. The decision-making process also integrates legal rules and policies with expert and non-expert evidence. This chapter discusses two major types of reasoning that have emerged to help bring about this remarkable social achievement: systems of rule-based deductions and patterns of evidence evaluation. In addition to those emergent structures, second-order reasoning about legal reasoning itself not only coordinates the decision-making, but also promotes the emergence of new reasoning structures. The chapter analyzes these types of reasoning structures using a many-valued, predicate, default logic – the Default-Logic (D-L) Framework. This framework is able to represent legal knowledge and reasoning in actual cases, to integrate and help evaluate expert and non-expert evidence, to coordinate agents working on different legal problems, and to guide the evolution of the knowledge model over time. The D-L Framework is also useful in automating portions of legal reasoning, as evidenced by the Legal Apprentice™ software. The framework therefore facilitates the interaction of human and non-human agents in legal decision-making, and makes it possible for non-human agents to participate in the evolution of legal reasoning in the future. Finally, because the D-L Framework itself is grounded in logic and not on theories peculiar to the legal domain, it is applicable to other knowledge domains that have a complexity similar to that of law and solve problems through default reasoning.

INTRODUCTION

The logical structure of legal reasoning, and especially its second-order reasoning about the reasoning process itself, is a primary mechanism by which new legal rules and new plausibility schemas emerge, and through which such rules and schemas adapt to the nuances of legal cases. This reasoning structure not only coordinates the efforts of numerous autonomous agents, but also promotes the emergence and evolution of new reasoning structures by responding to the tremendous variability provided by individual legal cases. This chapter describes the Default-Logic (D-L) Framework, which accurately models the logical structure of legal reasoning in actual legal cases. Moreover, it is the logical structure of legal reasoning itself, and not any particular set of rules within the legal knowledge domain, that creates this evolutionary mechanism. This means that the evolutionary mechanism captured by the D-L Framework can operate in domestic, foreign and international legal systems; that non-human autonomous agents can participate in this evolution, interacting with human agents; and that similar reasoning structures can operate in many knowledge domains other than law.

Legal reasoning is a distinctive method of reasoning that has emerged because of adherence to the rule of law. The rule of law requires that similar cases should be decided similarly, that each case should be decided on its merits, and that decision-making processes should comply with all applicable legal rules. One safeguard for achieving these fundamental goals is to make the reasoning behind legal decisions transparent and open to scrutiny. If the legal rules and policies are the same between cases, and the evidence and reasoning in particular cases are publicly available and subject to scrutiny, then the legal decisions in those cases are more likely to be evidence-based and consistent. Transparency makes the decisions less likely to be merely subjective, and more likely to have an objective rationale. An important means of achieving the rule of law, therefore, is articulating and scrutinizing the various elements of the reasoning exhibited in legal cases. Such reasoning involves interpreting constitutions, statutes, and regulations, balancing legal principles and policies, adopting and refining legal rules, adapting those rules to particular cases, evaluating the evidence in each case, and making ultimate decisions that are based on all of these elements.

Legal decision-making today requires many agents performing many different tasks. As the number and diversity of legal cases has increased, and the legal issues in those cases have become more specialized, it has become necessary to distribute the functions needed for optimal decision-making over more and more agents. First, these agents include the specialists in the law itself – the law-makers (legislators, regulators, and judges), the law-appliers (such as judges and administrative personnel), and the advocates using the law (the lawyers representing parties). Such agents, either individually or in groups, establish the legal rules (e.g., by enacting statutes or issuing regulations), clarify their meaning (e.g., when deciding motions), and ensure that the rules are applied in appropriate cases (e.g., by advocating for particular outcomes, rules and policies). Second, there are the agents (witnesses) who supply the evidence needed to apply the legal rules accurately. Some witnesses have personal knowledge of disputed issues of fact. Other witnesses are experts who have scientific, technical, or other specialized knowledge that is relevant in particular cases – for example, knowledge about forensic science, product testing, medical care or engineering. Such agents supply the evidence needed to apply the legal rules accurately. Third, there are agents who act as the "factfinders." Depending upon the nature of the proceeding, a jury, judge, or administrative official listens to the witnesses, reads the relevant documents, evaluates all of the evidence, and decides what that evidence establishes as the "facts" for legal purposes. In modern legal systems, with tens of thousands of legal cases, a very large number of autonomous human agents participate, and they together achieve reasonably fair and accurate decisions. This achievement is possible because the reasoning in those cases is organized and supervised under the rule of law; the law, evidence and reasoning are transparent and publicly available; and the decision-making processes are open to scrutiny.

This chapter examines the logical structure of the reasoning involved in such cases, with particular