BOOK REVIEWS

COMPUTING POWER AND LEGAL REASONING
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"But what is intelligence?
Nobody seems to know."[1]

INTRODUCTION

Neither science nor philosophy has been able to identify or define what constitutes intelligence. Nonetheless, "intelligent" systems have been developed to address and solve limited analysis problems or narrow domain problems. Although currently limited in application, these systems produce "result equivalent" solutions: the program produces the same answer(s) to a given problem as a human problem solver working on the same problem. Contrary to the suggestion of some program developers, however, this equivalence in results should not be confused with equivalence in procedure: the computer system has *not* necessarily paralleled human thought processes in arriving at the same results as the human problem solver.

It has been suggested that, as the domain of problems is expanded, paralleling human thought process will be required to achieve result equivalence. This theory is persuasive because the difficulty in maintaining result equivalence increases exponentially in relation to the complexity of the problem. Theoretical pondering alone, however, will never prove or disprove this theory. Only practical experience such as evidenced by the research in *Computing Power and Legal Reasoning* will provide the answers.

Very few books in the field of artificial intelligence successfully collect legal problems in a comprehensive manner. *Computing Power and Legal Reasoning* is an important exception. Based on the results of the First Annual Conference on Law and Technology (August 13 - 22, 1984) organized by The University of Houston Law Center Program on Law and Technology, the book contains selected research presentations given during the conference.

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1. Heather, *A Demand-Driven Model for the Design of a "Half Intelligent" Common Law Information Retrieval System,* in COMPUTING POWER AND LEGAL REASONING 82 (C. Walter ed. 1985).

A book this comprehensive is difficult to read and difficult to review because the research is so diverse in topic, presentation, and audience addressed. This review begins by proposing some reading guidelines and providing general comments about how to group the papers in the book. The second part of the review presents, in more detail, selected contributions that seem particularly instructive. This selection is based on the belief that the papers should not be too "technical" because lawyers interested in Artificial Intelligence (AI) research will look for introductory materials. Finally, this review isolates some key issues in the present legal AI-debate which are reflected in various articles contained in *Computing Power and Legal Reasoning.*

I. OVERVIEW OF THE CONTRIBUTIONS

What is the best way to read a book with such a diverse structure containing selected research presentations? Naturally, the answer depends on the interests of the reader. Assuming that most readers in the legal profession are interested in the practical application of AI-research, it is best to begin with the papers discussing working prototypes of legal expert systems, logic as an analytic tool for "normalization," and "intelligent" information retrieval techniques because these papers include familiar legal information and illuminate unfamiliar technical terms and systems.

The book begins with two very fundamental articles discussing cognition entitled "Natural Models of Intelligence"[2] and "Semantic Representations of Children's Blame Rules."[3] Though the analytical tools presented here are useful in every discipline, including law, the link becomes apparent only after detailed studies in the field. Therefore, articles which establish an explicit connection between instruments of cognitive methodology and legal problems are more appropriate as an introduction. Examples of this type of study are the contributions of Robert Krovetz,[4] Sydney Lamb,[5] and Dyer and Flowers.[6] The Dyer and Flowers article explores fundamental knowledge-oriented AI-applications[7] where logical, cognitive processes are the main point of interest rather than legal examples.

The remaining articles focus more expressly on legal oriented work than on its mental prerequisites, though the theoretical underpinnings of AI-research also form the background of these contributions. Once the reader is familiar with the papers of a more practical character, the more fundamental AI-contributions become accessible. These latter materials should not be overlooked, but beginning with them might frustrate an unprepared reader.

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2. Walter & Parks, *Natural Models of Intelligence, id.* at 5.
3. Hook, *Semantic Representations of Children's Blame Rules, id.* at F6
4. Krovetz, *The Use of Knowledge Representation Formalisms in the Modeling of Legal Concepts, id.* at 275.
5. Lamb, *Information and its Representation in English Texts, id.* at 145.
6. Dyer and Flowers, *Toward Automating Legal Expertise, id.* at 49.
7. *Cf. infra* Section II(A).

One important field is argumentation theory: Kevin Ashley analyzes "Reasoning by Analogy"[8] and Edwina Rissland studies "Argument Moves and Hypotheticals."[9] Legal interpretation, particularly of statutory texts, is a topic that is seen increasingly as a specific case of argumentation as discussed in the article by Franciszek Studnicki.[10]

To gain a perspective on the future of legal expert systems, the brief workshop report by Grayfred B. Gray[11] is the most informative. Gray describes the results of a brainstorming session with participants Kevin D. Ashley, Thomas H. Barthel, Helene Bauer-Bernet, Antonio Anselmo Martino, Pietro Mercatali, John Thorne and Don Waterman. This report provides not only a classification of basic functions in legal expert systems (Table II), a list of general classes of uses of legal expert systems (Table III), and an overview of classes of non-legal expert systems (Table IV), but also a comprehensive table listing possible uses of legal expert systems and the correlation between their uses and functions (Table I). This section is invaluable as an orientation to the field because most of the future developments in AI will probably proceed within this framework.

All AI-research in the law depends on two fields: cognitive analysis and legal methodology (including legal logic). Programming languages express the insights gained from both disciplines, and both are explored in depth in the book. For example, one group of papers concerns logic and programming languages. "Permissions and Obligations" by Thorne McCarty[12] treats the problem of representing permissions and obligations as part of a deontic system which avoids the well-known paradoxes of deontic logic. Thomas Gordon discusses "Object-Oriented Predicate Logic and its Role in Representing Legal Knowledge"[13] and introduces OBLOG as a programming utility of the object-oriented type that is more appropriate for dealing with legal questions than standard PROLOG-types.

"Normalizing" legal rules means transforming legal knowledge into a form that is easier to access and process. Logic is used as a practical tool when statutes are either enacted in a normalized form[14] or normalized after their enactment according to logical rules.[15] Normalization is also a central objective of programs that extract specific information out of large amounts of stored legal knowledge. The theory underlying such experiments is outlined by Antonio

8. Ashley, *Reasoning by Analogy: A Survey of Selected AI Research with Implications for Legal Expert Systems*, in COMPUTING POWER AND LEGAL REASONING 105 (C. Walter ed. 1985). *See also infra* Section II(B).

9. Rissland, *Argument Moves and Hypotheticals*, in COMPUTING POWER AND LEGAL REASONING 129 (C. Walter ed. 1985).

10. Studnicki, *Computational Aspects of Legal Interpretation*, *id.* at 157.

11. Gray, *Workshop Report*, *id.* at 621.

12. McCarty, *Permissions and Obligations*, *id.* at 573.

13. Gordon, *Object-Oriented Predicate Logic and its Role in Representing Legal Knowledge*, *id.* at 163.

14. *Cf.* Gray, *Statutes Enacted in Normalized Form: The Legislative Experience in Tennessee*, *id.* at 467.

15. *Cf.* Allen & Saxon, *Computer Aided Normalizing and Unpacking: Some Interesting Machine-Processable Transformations of Legal Rules*, *id.* at 495.

Martino[16] and Constantino Ciampi together with Deirdre Exell Pirro, Elio Fameli, and Giuseppe Trivisonno.[17]

Several of the remaining articles discuss legal knowledge contained in textual databases or presented in rule-form. Textual databases normally do not have precisely defined structures. This lack of structure makes searching for information a difficult task. Experts often identify the inadequacy of a purely Boolean search in unstructured full text-databases. As a result, more "intelligent" retrieval techniques have become a primary subject of evaluation. Hence it is not surprising that many participants of the Houston Conference were preoccupied with this issue. For example, Heather presents "A Demand-Driven Model for the Design of a 'Half-Intelligent' Common Law Information Retrieval System"[18] where Boolean Query is only one component supplemented by others. Another way to overcome the limitations of a normal text search is through the process called "conceptual retrieval." In this process certain concepts are marked with their respective relations so that they can be retrieved according to their structural properties. The advantages of this approach are shown by Cary deBessonet and George Cross with respect to legal causality.[19] Additionally, as the title "Beyond Keyword Interaction: Computerized European Community Law"[20] indicates, Bauer-Bernet presents a way out of the imitations set by traditional keyword-oriented retrieval.

When textual knowledge bases get highly structured, it is difficult to draw a clear boundary between them and expert systems. This distinction is difficult because an "intelligent" information retrieval system (IIR) contains—as do expert systems—a rule base and a fact database, as pointed out in "Inference Techniques for Intelligent Information Retrieval" by Gian Piero Zarri.[21] Although a distinction is perhaps desirable from a theoretical viewpoint, the similarity between these systems might mark a future tendency to link IIR's and expert systems conceptually.

Such a link is the topic of the last group of articles. An expert system handling the formation of contracts by offer and acceptance is presented by Anne Gardner.[22] A description of a French expert system designed to assist mayors in the field of noise problems is described in "About Intelligence in Legal Information Systems" by Daniele Bourcier.[23] "Tax Problem Solving with an If-Then System" is the subject of Duncan MacRae's article.[24] Mark Peterson

16. Martino, *Why an Automated Analysis of Legislation?, id.* at 413.

17. Ciampi, Pirro, Fameli & Trivisonno, *THES/BID: An Expert System for Constructing a Computer-Based Thesaurus for Legal Informatics and Computer Law, id.* at 375.

18. Heather, *A Demand-Driven Model for the Design of a "Half- Intelligent" Common Law Information Retrieval System, id.* at 69.

19. deBessonet & Cross, *Representation of Some Aspects of Legal Causality, id.* at 205.

20. Bauer-Bernet, *Beyond Keyword Interaction: Computerized European Community Law, id.* at 337. *Cf. infra* Section II(D).

21. Zarri, *Inference Techniques for Intelligent Information Retrieval,* in COMPUTING POWER AND LEGAL REASONING 215 (C. Walter ed. 1985).

22. Gardner, *Overview of an Artificial Intelligence Approach to Legal Reasoning, id.* 247. *Cf. infra* Section II(C).

23. Bourcier, *About Intelligence in Legal Information Systems,* in COMPUTING POWER AND LEGAL REASONING 319 (C. Walter ed. 1985).

24. MacRae, *Tax Problem Solving with an If-Then System, id.* at 595.

and Donald Waterman explain "An Expert System-Approach to Evaluating Product Liability Cases."[25] The programs with direct practical impact on lawyering include: "A Knowledge-Based Expert System Used to Prevent the Disclosure of Sensitive Information at the United States Environmental Protection Agency,"[26] "Choosing between a Chapter 7 and a Chapter 13 Bankruptcy: An 'Expert System' to Assist an Attorney in Making the Choice,"[27] and "TA—A Prolog Program which Analyzes Income Tax Issues under Section 318(A) of the Internal Revenue Code."[28]

Since the introduction of "intelligent" computing power into the realm of legal reasoning will change profoundly the whole professional environment of lawyering, an analysis of current developments would be incomplete without some reflections on this issue. Thus Marshal Willick gives an orientation to "some legal and ethical aspects of the use of computers as decision aids" including analysis of this use in relation to "professional malpractice and the unauthorized practice of professions."[29]

II. EVALUATION OF SOME SELECTED CONTRIBUTIONS

A. Toward Automating Legal Expertise, Michael G. Dyer & Margot Flowers, pp. 49 - 68.

This paper reports on the Foundations of Legal Expertise (F.L.E.) research project at the UCLA Artificial Intelligence Laboratory. As the authors stress, this research is in its initial stages. The paper incorporates the authors' insights gained from their experiences with three programs: BORIS (written for understanding stories), HARRY (designed for economic reasoning), and ABDUL (modeling political argumentation).[30]

It is important to note that Dyer and Flowers do not work with the primary aim of constructing legal "expert systems" to assist lawyers in their practical work. As they put it:

> our ultimate goal is neither the formalization of law as it exists, nor the construction of legal products intended to help lawyers out in their everyday tasks. . . . Rather, we have been drawn to law since it is an excellent task domain for performing experimental computational research on modeling human cognitive processes.[31]

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25. Peterson & Waterman, *An Expert System-Approach to Evaluating Product Liability Cases, id.* at 627. *Cf. infra* Section II(E).

26. Feinstein, *A Knowledge-Based Expert System Used to Prevent the Disclosure of Sensitive Information at the United States Environmental Protection Agency,* in COMPUTING POWER AND LEGAL REASONING 661 (C. Walter ed. 1985).

27. Boyd, *Choosing between a Chapter 7 and a Chapter 13 Bankruptcy: An "Expert System" to Assist an Attorney in Making the Choice, id.* at 699.

28. Schlobohm, *TA—A Prolog Program which Analyzes Income Tax Issues under Section 318(A) of the Internal Revenue Code, id.* at 765.

29. Willick, *Professional Malpractice and the Unauthorized Practice of Professions: Some Legal and Ethical Aspects of the Use of Computers as Decision-Aids, id.* at 817.

30. Dyer and Flowers, *Toward Automating Legal Expertise, id.* at 49.

31. *Id.* at 50.

Thus, the word "toward" in the title of this paper has to be emphasized: "Toward Automating Legal Expertise" really means "Fundamental Cognitive Research Needed in the Perspective of an Eventual Automated Legal Expertise." The long road ahead for this type of research becomes clear upon examining the topics identified by the authors that require further analysis:

- natural language comprehension and generation
- organization of episodic memory
- indexing, access, and retrieval of episodes from memory
- memory modification and learning through experience
- planning, counter-planning, and strategy formation
- argumentation, belief maintenance, and persuasion
- reasoning, common sense, and the formation of judgments
- processes of questioning, examination, and summary formation.[32]

The fundamental approach chosen by the authors leads them to ask some basic questions about memory organization, natural language and world knowledge, and analogical reasoning.

As for memory organization, strong evidence suggests that databases organized around lists of entities and attributes or relations are not sufficient to represent legal expert-knowledge efficiently. Instead, "a database of conceptual constructs, organized around beliefs supported by causality, planning, and reasoning" is required.[33] These conceptual constructs are organized on an "issue" level, allowing comparison of cases that may differ considerably at the level of content features. The authors claim that this type of memory-organization closely resembles the way life episodes are stored and recalled in human memory and therefore this memory-organization is required in a database designed to generate a product similar to that of human experts. Based on this assumption, it is inevitable that the available relational databases with cases indexed according to content features or details will not be capable of meeting these requirements.

According to Dyer and Flowers, another problem for legal expert systems, accepting natural language as input, is presented by the relationship between this input and the background of world knowledge required for applying legal rules to the facts. If the field for rule-application is very broad it becomes extremely difficult[34] to store all the relevant information about this "world" in an accessible form. Since the law is characterized by "an extremely broad range of complex constructs,"[35] restrictions have to be introduced to make expert systems work within the limits of their current "technological" capacities. This type of complexity is reflected in the fact that current expert systems only work in domains "characterized by a small number of constructs will [sic] relatively well-defined relationships."[36]

32. *Id.*
33. *Id.* at 54.
34. These difficulties are demonstrated by the authors with two examples drawn from a program called WILL WRITER and a tax advisory system. *Id.* at 56.
35. *Id.*
36. *Id.*

Stressing the important role of legal analogy, Dyer and Flowers criticize the dominating rule-based approach in current AI-research as applied to the law. Because laws normally take the form of rules, it is generally concluded that this domain is especially well-suited for rule-oriented representation. However, experienced lawyers reason by case analogy not by strict legal rules; given a problem they solve it by means of "one or more prototypic cases which involve similar issues."[37] This implies that lawyers recall cases which are indexed around their relevant differences.

Dyer and Flowers argue for a cognitive approach that takes into account the fundamental characteristics of legal reasoning which differ (according to them) in many ways from the currently accepted AI-"technology." Because of the complexity of the task they have outlined as necessary for an "intelligent" system, they feel entitled to conclude: "the legal profession, and population in general, should not expect to see the truly *basic* cognitive skills of lawyers replaced by any form of AI system for quite some time."[38]

B. Reasoning by Analogy: A Survey of Selected AI-Research with Implications for Legal Expert Systems, Kevin D. Ashley, pp. 105 - 127.

The key role of reasoning by analogy in the legal field is well known and undisputed.[39] In discussions about possible legal AI-applications, it is a common claim that reasoning by analogy cannot be represented by a computer program. If this is true, one of the most important activities performed by a lawyer would be excluded from the domain of expert systems, thus severely limiting their range. Ashley examines whether such a limitation must be accepted by analyzing the research on analogical reasoning conducted by Burstein, Winston, Carbonell, and Genesereth.

One of the important results of Ashley's work is an explication of the theory underlying the program CARL written by Burstein. This program is designed to "learn" how variable-assignments take place in the BASIC programming language through the use of analogy. The starting point is knowledge about a base domain. This knowledge then is transferred to a target domain. The transfer is accomplished by "mapping" the resulting abstractions from the base domain into the target domain. For example: in the base domain objects are moved between boxes. The abstraction necessary for an analogous conclusion consists in the representation that "moving between boxes" means "taking an object out of a box and putting an object into a box."[40] Starting with the assumption that variables are like boxes, this abstraction allows reasonable guesses if questions are asked about moving numbers between variables.

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37. *Id.* at 57.
38. *Id.* at 65.
39. E. LEVI, AN INTRODUCTION TO LEGAL REASONING (1949).
40. Ashley, *Reasoning by Analogy: A Survey of Selected AI-Research with Implications for Legal Expert Systems*, in COMPUTING POWER AND LEGAL REASONING 112 (C. Walter ed. 1985).

In applying Burstein's basic concept of "abstraction mapping" to the legal field, Ashley argues that Burstein's approach is equivalent to saying that "analogies provide roles for facts to play (emphasis deleted)."[41] This means that the facts play a similar role in the "box-world" and the "variable-world." "For example, as a result of the analogy between variables and boxes, an indirect correspondence is set up between the 'situational role' of a physical object that is inside the box and a number assigned to a variable."[42] This sounds highly theoretical, but Ashley links this starting point to a real program called HYPO. This program "generates and modifies hypothetical cases in the domain of trade secret protection of software."[43] The trade secret cases incorporated into this program are analyzed with respect to so-called "dimensions," for example "unfair competitive advantage," "generally known," "learnable elsewhere," "vertical knowledge," "telltale signs of misappropriation," "noncompetition agreement," "accessible by others," "confidentiality agreements constraining access," "duration of noncompetition prohibition."[44] According to Ashley, these dimensions perform the same function as Burstein's "abstractions:"[45] they are used to indicate whether a plaintiff's argument is strengthened or weakened. The cases are indexed with respect to the dimensions represented in each case. Ashley proposes the construction of a legal expert system which would compare the similarities of given cases to the cases contained in the database and index them according to their "dimensions." This system would perform "analogical reasoning" in asserting "the strengths and weaknesses of the parties' respective cases in terms of relevant precedents which it had located in the database and would make arguments in favor of the respective parties."[46]

There can be no doubt that the AI-representations of analogical reasoning are far from a true and complete cognitive model of this type of human activity. Ashley is quite aware of these limitations.[47] Nevertheless Ashley's concept of a legal expert system which incorporates some features of analogy described in current AI-research suggests that some practical work can be done in the framework of this theory.

C. Overview of an Artificial Intelligence Approach to Legal Reasoning, Anne v.d.L. Gardner, pp. 247 - 274.

This paper describes a program that focuses on cases concerning the formation of contracts by offer and acceptance. The program contains three essential elements: general knowledge, legal categories, and legal rules. General knowledge provides both a language which allows the description of cases and a generalization hierarchy stating relations between class names (*e.g.*, "every

41. *Id.* at 115.
42. *Id.*
43. *Id.* at 116.
44. *Id.* at 119-20. *See also* Rissland, *Argument Moves and Hypotheticals, id.* at 133.
45. Ashley, *Reasoning by Analogy: A Survey of Selected AI-Research with Implications for Legal Expert Systems, id.* at 119.
46. *Id.* at 116.
47. *Id.* at 109, 112.

house is a building," "every letter is a document," etc.). General knowledge and legal categories are integrated into a transition network. This type of representation was chosen because the sequencing of events is critical in offer and acceptance problems. The nodes of this network represent legally distinct states like "an offer is pending" or "a contract exists." The arcs of the network correspond to legal categorizations of events and are labeled "offer," "acceptance," etc. Each arc has associated legal rules formulated in a declarative if-then format, allowing the system to determine whether the corresponding legal category is present in a given problem (*e.g.*, is there an offer, is there an acceptance).[48]

A distinctive feature of the program is its ability to handle open-textured predicates. An open-textured predicate is defined as a "predicate that occurs in the antecedent of some legal rule but whose meaning is given neither by further rules nor by an attached procedure."[49] To solve the problems of open texture, three heuristic rules are used. The first one directs the program to refer to the ordinary nontechnical meaning of a word. If this fails, there are two additional strategies. One flags for human judgment, the critical points at which choosing between conflicting definitions leads to different results. The other strategy uses cases stored in the system. These cases provide "extensional or semantic definitions of legal predicates."[50] Once a tentative conclusion has been reached using the heuristics described, the program tries to defeat this tentative conclusion by matching it with other information contained in the system (*e.g.*, other cases). Through this testing process the program identifies "hard legal questions" such as when two precedents are in conflict.

One of the most important features of the program is its ability to generate and test highly complex legal structures. According to Gardner, even in a simple example "[t]he number of choices is somewhat larger than a human lawyer would be likely to consider explicitly."[51] Because this transition network has an average branching factor of 5.25, the complexity of a problem can be calculated by raising 5 to the power of the number of events occurring in the case. A complete analysis of such a complex problem is impossible without the use of some kind of tool. If completeness of analysis is necessary for successful legal work, programs of this type may prove to be useful tools.

D. Beyond Keyword Interaction: Computerized European Community Law, Hélène Bauer-Bernet, pp. 337 - 374.

There is a common agreement that full-text retrieval systems are limited to searching with Boolean combinations of index terms and do not perform adequately to meet advanced needs. This paper examines projects in the field of European Community Law that are designed to overcome these limitations. The method employed in these projects is an attempt to "structure" a database

48. Gardner, *Overview of an Artifical Intelligence Approach to Legal Reasoning*, *id.* at 259 (for this form of representation).
49. *Id.* at 260.
50. *Id.* at 264.
51. *Id.* at 266.

according to linguistic and logical categories. The paper contains a detailed summary of this method and includes examples.

The fully documented examples regarding the European Community Anti-Dumping Regulation and the British Welfare Benefits legislation are especially worth reading because they demonstrate the application of an elaborate technique called "actantial analysis." The central point of the actantial analysis, developed by Tesniere, is the transformation of a given set of propositions into a tree structure with one ultimate predicate. The fundamental units of this tree structure consist of a "process," the "actants" and the "circonstants." To give a simple example: in the sentence "The parents give a book to Mary on her birthday," the "giving" (= process) is linked to "parents" (= active actant), "Mary" and "book" (= passive actants), and "on her birthday" (= circonstants). On the basis of this analysis, the information contained in a sentence is presented in a structured manner indicating, for example, which persons are subject to a process.

Actantial analysis leads to three main positive results. First, it expands avenues for information retrieval by permitting users to ask questions on the more general level of the actantial categories, rather than limiting users to words contained in the text. Thus, as the title suggests, users can go "beyond keyword interaction." Another advantage stems from the fact that the actantial model is capable of transformations. In Tesniere's version, the active and passive "actants" could switch places (*e.g.*, "they give a book" and "a book is given by them"), but the "circonstant" could not be transformed. However, Maurice Solet has provided an important extension of the theory to overcome this limitation. As a consequence of this enhancement, the actantial structure becomes more flexible and can be rearranged. Finally, the "output" of the "actantial analysis" can serve as the basis for a decision model. The easiest version of such a model uses the tree structure created by the actantial analysis in a linear fashion.

In summary, Bauer-Bernet describes a method for transforming legal texts into a structured knowledge system and demonstrates that the "surface structure" currently limiting information retrieval can be supplemented by the "depth structure" analyzed in the paper.

E. An Expert Systems Approach to Evaluating Product Liability Cases, Mark A. Peterson and Donald A. Waterman, pp. 627 - 659.

The expert system "LDS" developed by Peterson and Waterman is based on broad empirical research in the field of personal injury claims. Experts (lawyers and claims adjusters) were interviewed about the way they reach decisions in the field of product liability claims. Actual closed claims served as the basis for these interviews. By systematically varying the case features, the authors obtained a comprehensive evaluation of the relevant parameters.

The results of the interviews were cast into rule-form and implemented in the programming language ROSIE. For example:

If the plaintiff's injury did cause

(a temporary disability of an important function)

and the plaintiff's doctors were not certain about the disability being temporary

and the plaintiff's recovery was almost complete

and the condition is fixed,

increase the fear factor by $1,000 per day.[52]

While the rule-system proved useful for representing the reasoning followed by experts in specific cases, it was limited to a certain level of analysis: "by themselves, the systems do not provide a general conceptual structure that can help us understand legal decision-making. The rules are too specific, while the chains of reasoning are ad hoc products of the facts in particular cases."[53] This observation led the authors to formulate a general conceptual structure and a step-by-step scheme for decisions litigators make in evaluating civil liability claims. The authors propose that litigators consider the following "issues" when they evaluate claims:

Analysis of loss:
setting a dollar value for the plaintiff's loss.
Analysis of liability:
estimating the probability of establishing liability against a defendant.
Analysis of responsibility:
estimating the proportion of responsibility that should be assigned to a plaintiff for his own carelessness.
Analysis of characteristics:
rating for characteristics of the litigants, lawyers, judges, and jurisdictions (*e.g.*, skills of attorneys etc.).
Analysis of context:
adjusting the case value for matters of strategy, timing, and the type of claim.[54]

These components are then correlated using the following formula:

VALUE = LOSS * LIABILITY * RESPONSIBILITY * CHARACTERISTICS * CONTEXT

52. Peterson and Waterman, *An Expert Systems Approach to Evaluating Product Liability Cases, id.* at 631.
53. *Id.* at 632.
54. *Id.* at 636-38.

The authors claim that "[t]he schema, and the rules that flesh out the schema, provide a precise and explicit account of the relationship among all elements that influence litigators' decisions."[55] This claim is well-supported by the practical example used in the paper for illustration purposes.[56]

The system is a powerful tool for hypothesis generation and hypothesis testing. Once a hypothesis is created, through interviews or on the empirical evaluation of civil jury verdicts, it can be tested by running the ROSIE program against selected data. The result is an analysis of the case that either proves to be acceptable or demands refinement of the schema or the rules in light of the new evidence tested. By virtue of these procedures the model gradually approaches the reality of claim settlement with an increasing degree of accuracy.

The following conclusion drawn by the authors is well-supported:

> Our work to date indicates that rule-based expert systems can be developed and used to understand decisions involved in civil litigation. We can extract a great deal of information by systematically interviewing lawyers; this information can be translated into the if-then rules of a rule-based system, and that system can capture much of the richness and flexibility of legal reasoning.[57]

It is important to note, however, that these positive results are due to a limitation acknowledged by the authors: the system works on cases with a homogeneous structure; it solves problems "in some narrow domain."[58] In order to further improve these results, a new version of the system will be limited to analysis of asbestos litigation. Under the present circumstances, a pragmatic approach of this type may be the only way to construct truly operational expert systems for legal reasoning.

III. CONCLUSION: KEY ISSUES IN THE PRESENT LEGAL AI-DISCUSSION

Perhaps the most fundamental issue in the present legal AI-discussion is whether a rule-based approach is capable of paralleling a lawyer's problem-solving activity in finding and applying the law. This debate is not specifically limited to the legal field, but concerns AI-research in general. Whether experts are guided by rules or by the application of cognitive skills which are fundamentally different is in dispute.

In order to clarify the different positions presented in this debate, an important distinction must be made between results and methods. While the results an expert reaches can be paralleled by a rule-based expert system, this does not mean that the human expert has reached his result by following rules (or more specifically, by following the rules contained in the expert-system). In other words, equivalent results do not imply equivalent methods. Anne Gardner stresses this point and contends that the result of "a legally plausible conceptualization of the domain" is "a conceptual analysis of legal reasoning,

55. *Id.* at 639.
56. *Id.* at 633-35 ("champagne bottle case").
57. *Id.* at 653.
58. *Id.* at 629.

not a psychology."[59] If this is true, the argument that legal experts do not reach their results on the basis of rules loses its value as an argument against the viability of constructing rule-based expert systems.

The true test for the validity of such systems is whether equivalent results are reached by the system and by a human expert working on the same problems. This test goes beyond the basic idea of the Turing test—if the "output" of an expert system and the "output" of a human problem-solver become indistinguishable, the distinction is no longer of practical interest. Peterson and Waterman's system provides a very sound basis for this kind of test. The results of their rule-based system can be constantly compared with the results reached by lawyers and claim adjusters. If the results coincide, it can be considered proof of "result equivalence." This equivalence is sufficient for an efficient expert system, regardless of whether the system and the human expert use the same procedure to obtain the same result.

Peterson and Waterman assume, however, that their model reflects the method human experts actually use to make decisions:

> When presented with facts for a claim, the model will produce a chain of reasoning for evaluating the claim. This analysis can be compared with analyses of litigators for those claims or with the actual outcomes of claims. This provides us with an efficient and effective mechanism for performing the hypothesis testing.[60]

Limiting the comparison to "the actual outcomes of claims," corresponds to the weak "result equivalence" thesis discussed above. For purposes of hypothesis testing, however, the system's analysis (understood as "chain of reasoning") is matched with the way real lawyers have reached their results. This corresponds to the much stronger "procedural equivalence" thesis which counters the argument that human problem-solvers use cognitive skills which are different from rule-application.

The interesting fact is that Peterson and Waterman indicate they have found sufficient evidence supporting their "strong" (procedural equivalence) hypothesis.[61] This does not settle the question of whether experts in the law proceed according to rules, however, because Peterson and Waterman have introduced an important restriction in their work. They define an expert system as "a computer program that embodies expertise and knowledge supplied by human experts and uses artificial intelligence techniques to solve problems in some narrow domain."[62] The key words here are "in some narrow domain." If a relatively well-structured, limited domain of the law is chosen, it seems highly probable that the results of Peterson and Waterman can be reproduced. Indeed, the other expert systems presented in *Computing Power and Legal Reasoning* are examples pointing in the same direction. These examples do not resolve, however, that expert problem-solving can be considered a rule-oriented and

59. Gardner, *Overview of an Artifical Intelligence Approach to Legal Reasoning, id.* at 248.

60. Peterson and Waterman, *An Expert Systems Approach to Evaluating Product Liability Cases, id.* at 639-40.

61. *Id.* at 653.

62. *Id.* at 629.

rule-directed activity in the field of law. Future research will have to address the following questions:

> Is it possible to broaden the fields of law represented in rule-based expert systems without sacrificing "result equivalence?" Is it possible to find "procedural equivalence" between human and expert system behavior, when rule-based expert systems are no longer limited to some narrow domain?

These questions cannot be answered theoretically; rather the answers lie in continuing efforts to develop such expert systems. Consequently, the practical work described in *Computing Power and Legal Reasoning* has to be continued. There is no theoretical alternative.