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Source: *The Modern Law Review*, Mar., 1986, Vol. 49, No. 2 (Mar., 1986), pp. 168-194

Published by: Wiley on behalf of the Modern Law Review

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EXPERT SYSTEMS IN LAW: A JURISPRUDENTIAL APPROACH TO ARTIFICIAL INTELLIGENCE AND LEGAL REASONING

THE purpose of this paper is to offer a general introduction to the field of Artificial Intelligence and Legal Reasoning. More specifically, the topic of Expert Systems in Law is addressed, and one approach to the construction of these systems is advocated. In Section I, possible motivations for building expert systems in law are noted. In Section II, the terms artificial intelligence and expert systems are discussed resulting, in Section III, in a characterisation of expert systems in law. In Section IV, current projects in artificial intelligence and legal reasoning are briefly surveyed and the idea of introducing jurisprudential rigour to the process of building expert systems in law is first advanced. This notion of using legal theory as a point of departure in the construction process is developed in Section V in a discussion of the concepts of legal knowledge acquisition, legal knowledge representation and legal knowledge utilisation. In the concluding Section VI, directions for further research in this field are identified and an interdisciplinary research project, currently being conducted at the University of Oxford, is described.

Although this essay is intimately concerned with an aspect of computer science, it is intended that the bulk of it will be comprehensible to those who have no knowledge of the new technology. For it is generally not necessary for the lawyer or legal theorist to understand the computer and appreciate the intricacies of logic and mathematics as does a computer scientist, a computer engineer, logician or mathematician. For the purposes of examining possible functions of computers in the legal world, the lawyer need only familiarise himself with certain crucial matters, such as the potential, the limitations, and the dangers of their introduction to legal practice and research.

I

The first 25 years of research into the application of computer technology to the law were devoted largely to the development of what are generally, but, it shall be argued, misleadingly, termed legal information retrieval systems.

Many legal practitioners and academics are now familiar with the operation and capabilities of these systems, the best known of which in the United Kingdom is LEXIS. While the precise sequence of operations to be followed in their actual use varies from system to system, ordinarily the user operates through a terminal and having initially executed various preliminary instructions in order

to gain access to the system, then enters one or more keywords, that is, words he considers to be important for, and relevant to, his inquiry. The computer then compares these keywords with the concordance of the full-text (or perhaps only head notes) of that section of the database in which the user has chosen to search. (The concordance is an alphabetical index of almost all the database's words and their addresses.) Seconds later, the number of occurrences of the selected keywords in the material searched appears on the screen. If that number is too great to be easily managed or too small to be of assistance, then the search can be modified by entering additional or alternative keywords or by the addition of further conditions. When the number is deemed convenient, the computer can be instructed to display them on the screen in one of a variety of ways, first, perhaps, by presenting those parts of the text that contain the keywords and then, if the user so chooses, by exhibiting the full-text itself. After browsing the user may then instruct the computer to print out any desired portions of text.

In order to appreciate their various shortcomings, it is necessary to have a rudimentary understanding of certain key aspects of these systems' operation. One of the first steps in their construction is the creation of a database which involves the loading of selected materials (for example, statutes and case-reports) into the computer's memory, utilising it as a sort of library. This source material may be stored on a full-text, abbreviated-text or head-notes basis. At this stage when the legal material is input, the system assembles its concordance. While in operation, the system identifies and then matches the string of characters (that constitutes the keyword), with this concordance. In more complex search requests, involving several keywords and connectors (for instance, the disjunctive connector, or, and the conjunctive connector, and) the system compares the addresses of these words in a fashion stipulated by the relationships established through the use of the connectors. The occurrence of the keyword(s) in the full text (or head notes) of documents, therefore, is the determinative factor with regard to the relevance, or otherwise, of the data retrieved.

While it is now generally accepted that computers can be used in the way just outlined as highly efficient tools for the recovery of legal material, many believe, nevertheless, that this criterion of relevance implicit in the systems is unsatisfactory. As a result, it is argued, many searches deliver an excess of irrelevant documents or fail to produce the bulk of those relevant texts that are in fact stored within the database.¹ To overcome this shortcoming, some

¹ In the LEXIS Handbook (1981), for instance, it is pointed out (p.24) that a hypothetical researcher who had intended to retrieve data containing the words *executor* and *executrix*, having entered the search request "execut!" would be confronted not only by texts carrying those terms he was looking for, but also those holding *execute*, *execution*, and *executive*. (The use, in this example, of the exclamation mark, known as

have endeavoured to develop other methods of searching stored documents (for example by citation vectors)² remaining, nonetheless, within the paradigm of what we shall term legal database systems (see Section III). Others, however, with a similar goal in mind—that of improving the performance of computer systems used to recover legal material—have sought to examine the possibility of knowledge-based systems in law.

Still others, for an entirely different reason, have also been motivated to the investigation of knowledge-based systems. This last group subscribe to the view that the so-called legal information retrieval systems are of minimal utility to the majority of practising lawyers whereas systems that could hold the kind of heuristic knowledge contained in such materials as practitioners' texts and handbooks, might, in contrast, prove to be of inestimable practical value.³

There has, then, been a gradual appreciation by many workers in the field that it is now necessary to attempt to develop computer systems in law that can be said to embody knowledge, and even exhibit intelligence. Achievements over the last twenty years, in the branch of computer science referred to as Artificial Intelligence (A.I.), have perhaps now provided the appropriate technological framework within which the construction of such knowledge-based systems in law might now be undertaken. Indeed, although similar such systems were anticipated by Lee Loevinger in 1949,⁴ and by Lucien Mehl in 1958,⁵ it is unlikely that their aspirations would now be receiving such serious consideration but for the apparently stunning advances that have been made recently by computer scientists involved with A.I.

II

Perhaps the most intellectually stimulating issue to have arisen from the advent of computer technology concerns the idea of

the super-universal character, results in the computer searching its concordance for all strings of characters with the prefix *execut*). Another interesting example given (p.12) indicates how relevant texts may be missed: the user who entered the keywords "warehouseman's lien" would miss some of those cases where that concept is referred to as warehouseman's possessory lien, lien of a warehouseman, warehousekeeper's lien or warehouse keeper's lien. It can be forcefully argued, of course, that many of the alleged deficiencies of systems such as LEXIS are in fact no more than users' inability to formulate suitable search requests.

² e.g. Colin Tapper, *An Experiment in the Use of Citation Vectors in the Area of Legal Data NORIS* (36) (1982).

³ For evidence of the contention that many lawyers have less need for access to primary legal sources than to lawyers' "know-how," see generally *Lawyers and Technology (The Slot Report)*, The Report of a Study of the Use of Technology by Solicitors (1983) and particularly pp.33-34, pp.36-40, and p.124.

⁴ "JURIMETRICS—The Next Step Forward" in 33 *Minnesota Law Review* (1949) 456-493.

⁵ "Automation in the Legal World—from the Machine Processing of Legal Information to the 'Law Machine'" presented at the National Physical Laboratory Symposium No. 10. entitled *Mechanisation of Thought Processes*. (Volume II). Proceedings of a Symposium held at the National Physical Laboratory on November 26-27, 1958. pp.756-779.

artificial intelligence.⁶ This topic has attracted comment from exponents of many diverse disciplines. Many problems of philosophy of mind and of cognitive psychology, for instance, are now being contemplated in a fresh context, relating them to this novel possibility of imbuing a machine, a computer, with artificial intelligence. As a result, much debate on A.I., pertaining as it does to the metaphorical relationship between man and machine, can hardly be regarded as an unfamiliar province of academic inquiry. For Western philosophers have puzzled over the nature of intelligence and related concepts for countless centuries and, more recently, even prior to serious A.I. work of any kind, intelligence had been under thorough experimental and theoretical scrutiny by cognitive psychologists. While many of the issues that are discussed under the rubric of A.I. are of intense interest to representatives of certain academic disciplines, it is sufficient for those concerned with A.I. and legal reasoning to characterise A.I. in a fashion that avoids the many conceivable philosophical, psychological and linguistic technicalities.

In our present context, the term artificial intelligence can perhaps best be regarded not as derived, by analogy, from the rigorous conceptions of philosophers, psychologists and linguistic scientists, but as a label used to refer to what it seems that certain computer systems possess to some degree. Such systems, having been so designed and constructed to perform those tasks and solve those problems that together if performed by human beings are taken by us to be indicative of intelligence, can be said to exhibit Artificial Intelligence. On this account, then, the term artificial intelligence connotes a *prima facie* intelligence and this designation, while perhaps lacking in philosophical rigour, serves simply as an explanatory, and metaphorically framed, classification.⁷ Of course, the term artificial intelligence might most realistically be regarded not as a label to be appended without due regard to time; for A.I.

⁶ Despite the current profusion of interest in A.I., there seems to be some confusion over the precise date that the term was introduced into our vocabulary. In *The Times* (September 6, 1983, p.8) it was claimed that John McCarthy, of Stanford University, coined the phrase in 1958, whereas Feigenbaum and McCorduck assert, with less conviction, in *The Fifth Generation* (1983), that the name was invented "around 1956" (p.38). Many theorists are not impressed by this choice of terminology anyway, often finding it objectionable because it allegedly deprecates a dignity to be associated with human intelligence. It is not clear, however, which constituent word is the offending unit, for some adopt machine intelligence as a substitute epithet while others seek to employ the expression artificial thinking as a more appropriate appellation. In any event, the actual label appended is of little consequence: attention might more fruitfully be paid to the manner in which the term is used and to the problems created by, and the theories discussed in relation to, the concept of A.I.

⁷ We are, therefore, not directly concerned here with the core A.I. question of whether machines can meaningfully be said to think. The expert systems in law discussed in this paper will be no more capable of thinking, in the sense of having cognitive states, than legal textbooks. On machine thought, see A.M. Turing, "Computing Machinery and Intelligence" *Mind*, Vol. LIX, No. 236 (1950), Ned Block, "Psychologism and Behaviourism" *Philosophical Review*, January 1981, pp.5-43, Douglas Hofstadter and Daniel Dennett (eds.), *The Mind's I* (1982).

research can also be seen as no more than sustained attempts to program computers to exhibit forms of intelligent behaviour, for the production of which we do not seem today to have the necessary computational knowledge.

There are many tasks that computer scientists are currently endeavouring to program computers to perform which are deemed to result in artificially intelligent computer behaviour: the understanding and translation of natural language (Natural Language Processing); the understanding of the spoken word (Speech Understanding); the recognition of images and objects of the physical world (Vision and Perception); the playing of complex games such as chess (Game Playing); learning from examples and precedents (Machine Learning); the writing of programs, that is, computer programs that can themselves generate programs (Automatic Programming); the sophisticated education of human users (Intelligent Computer-aided Instruction or Tutors); intelligent problem-solving and reasoning (Intelligent Knowledge-Based Systems (I.K.B.S.) or Expert Systems). Moreover, attempts to build intelligent robot systems (Robotics), and the study of the human mind using the computer as a means of testing hypotheses and modelling human behaviour, that is, using what is commonly referred to as the Computational Metaphor, are also considered to be contributions to the study of A.I.⁸

The particular aspect of A.I. from which the legal profession may well benefit is often regarded as the applied branch and is usually referred to as Intelligent Knowledge-Based Systems (I.K.B.S.). These are systems that contain representations of knowledge which can be deployed in the solving of given problems. Expert Systems (despite the fact that this term is often considered to be synonymous with I.K.B.S.), are, more precisely, a type of I.K.B.S. Expert systems are computer programs that have been constructed (with the assistance of human experts) in such a way that they are capable of functioning at the standard of (and sometimes even at a higher standard than) experts in given fields. They are used as high-level intellectual aids to their users; this explains their alternative epithet: intelligent assistants. They differ from I.K.B.S. in that the latter may recognise speech, perceive images or indeed solve problems in a fashion that undoubtedly is dependent on knowledge yet that requires no particular human expertise. Only those I.K.B.S. that embody a depth and richness of knowledge that permit them to perform at the level of an expert in a particular (and normally highly specialised) domain, therefore, ought then to be designated expert systems.

⁸ On artificial intelligence in general, see Patrick Winston, *Artificial Intelligence* (2nd ed., 1984), N. J. Nilsson, *Principles of Artificial Intelligence* (1980), J. E. Hayes and D. Michie (eds.), *Intelligent Systems* (1983), Edward Feigenbaum and Pamela McCorduck, *The Fifth Generation*, op. cit. *supra*, note 6, Michie and Johnston, *The Creative Computer* (1984).

The above characterisation of expert systems, however, requires considerable refinement in terms of various attributes that are generally expected of them (although there is some confusion even amongst computer scientists over what programs can correctly be termed expert systems).⁹ Expert systems are usually: (1) transparent, which means that they can generate explanations of the lines of reasoning that lead them to their conclusions; (2) heuristic, by which is meant they reason with the informal, judgmental, experiential and often procedural knowledge that underlies expertise in a given field (as well as with the more formal knowledge of the domain in question); and (3) flexible, a term that refers to the ability of these systems to allow, without any great difficulty, modifications to their knowledge bases, that is, to their stores of knowledge.¹⁰

Further insight into expert systems can be gained through appreciation of the three major research issues in this wing of computer science.¹¹ First, there is the matter of knowledge acquisition. Work on this topic addresses the manner in which the requisite knowledge, particularly the heuristic knowledge, can be extracted from human experts, and then articulated with a view to representing it in the system. Secondly, is the issue of knowledge representation, which concerns the techniques to be adopted in the process of restructuring the body of knowledge of a particular domain so that it can be represented as data structures within the computer's memory. This has to be done in a fashion that not only facilitates subsequent alterations to the knowledge base, but also makes for easy access during the problem-solving routines. Further, this representation is required to be a configuration faithful in meaning to the original corpus of knowledge. Thirdly, is the question of knowledge utilisation. This pertains to the inference procedures, that is, to the methods of reasoning, to be used by the system in the process of problem-solving. For all expert systems require an inference engine, the mechanism by which the knowledge base interacts with the data relating to any problem at hand, so that conclusions may be drawn. The person whose role it is to build expert systems, and, therefore, to consider appropriate methods of knowledge acquisition, representation and utilisation in respect of any project with which he may be concerned, is known as the knowledge engineer.

⁹ See Bruce G. Buchanan and Richard O. Duda, *Principles of Rule-Based Expert Systems* (Stanford University, Report No. STAN-CS-82-926), p.1. On expert systems generally, see Frederick Hayes-Roth, Donald A. Waterman and Douglas B. Lenat (eds.), *Building Expert Systems* (1983), D. Michie (ed.), *Introductory Readings in Expert Systems* (1982), D. Michie (ed.), *Expert Systems in the Micro-electronic Age* (1979). See also the Department of Industry, *A Programme for Advanced Information Technology (The Alvey Report)* (1982), pp.32-35.

¹⁰ See *Principles of Rule-Based Expert Systems*, *op. cit. supra*, note 9, p.1.

¹¹ See *Intelligent Systems*, *op. cit. supra*, note 8, pp.37-55. Also *The Fifth Generation*, *op. cit. supra*, note 6, Chap. 3.

Applications of expert systems have been many and various.¹² Arguably the first sustained, and ultimately successful, work in this field, was initiated in 1965. This was the DENDRAL project, carried out at Stanford University and inspired by one of the fathers of A.I., Edward A. Feigenbaum. By harnessing the formal and heuristic knowledge both of Joshua Lederberg (a professor of genetics and Nobel laureate), and of Carl Djerassi (a physical chemist renowned for having invented the birth control pill), Feigenbaum wrote a program that can infer the molecular structure of an unknown molecule given the mass spectroscopic data that would normally be available to a physical chemist engaged in such a task. The system's capabilities in this sphere are now said to exceed those of any single human being (including its designers), and it is used in university and industrial environments throughout the world. Another expert system, PROSPECTOR, functions as an intelligent assistant for geologists by offering advice on the location of ore deposits based on geological data. As a direct result of its advice (its knowledge base contains the heuristic and formal knowledge of scientists of the U.S. Geological Survey), it is claimed that a molybdenum find, valued at one hundred million dollars, was made in 1982.

Perhaps the most widely known expert systems are those that perform medical diagnoses. MYCIN, for instance, a system developed at the hands of a doctor-cum-computer scientist, Edward H. Shortliffe, provides consultative advice on diagnosis and antibiotic therapy for infectious diseases such as blood infections and meningitis. CADUCEUS (formerly INTERNIST), performs diagnoses (at a level of expertise that permits it to cope with the case studies of the Clinical Pathological Conferences), in the field of internal medicine, 80–85 per cent. of which domain is represented in its knowledge base. Finally, CASNET diagnoses, and advocates therapeutic measures for, the disease process of glaucoma, doing so in a fashion, it is averred, that ophthalmologists have acclaimed to be akin to that of an expert in the field.

Inspired by such successes, it is likely, some lawyers have suggested the possibility of "legal diagnostics"¹³ and expert systems for lawyers,¹⁴ while various computer scientists, flush with their colleagues' achievements, have turned to the domain of law in order that they might widen their range of conquests.

III

Based on the foregoing, we might expect expert systems in (substantive) law, meaningfully so-called, to correspond to the

¹² For details, see *Building Expert Systems*, *op. cit. supra*, note 9, and Avron Barr and Edward Feigenbaum (eds.), *The Handbook of Artificial Intelligence* Vol. 2 (1982).

¹³ Simon Chalton, "Legal Diagnostics" in *Computers and Law*, No. 25, August 1980, pp.13–15.

¹⁴ Bryan Niblett, "Expert Systems for Lawyers" in *Computers and Law*, No. 29, August 1981, p.2.

following tentative characterisation. They are computer programs that have been written with the aid of legal experts in particular, and usually highly specialised, areas of law. (Systems lacking the specialisation requirement, yet possessing the other expert systems' attributes mentioned in the previous section, we might more correctly term I.K.B.S. in law.) These expert systems are designed to function as intelligent assistants in the process of legal problem-solving (and can also be used as teaching aids). The users of such systems are intended to be general legal practitioners, who, when faced with legal problems beyond their range of experience and knowledge, rather than always having to turn to appropriately qualified legal specialists, may instead consult their expert systems in law. Such systems ask questions of their users and guide them through the problem-solving process, utilising the embodied heuristic and formal knowledge of the experts who assisted in their design. Moreover, these systems offer explanations for their lines of reasoning and may be required to provide authority for all assertions made and conclusions drawn.¹⁵

However, although there are several claims of existing expert systems in law, close examination of the documentation of the systems invariably reveals these pronouncements to be exaggerated. Phillip Leith, for instance, has suggested that his "legal expert system, E.L.I., produced at the Open University is not only the first legal expert system but one of the few demonstrable expert systems in the U.K."¹⁶ E.L.I. is indeed a significant program, but according to the paper from which that quotation was taken, it is not transparent, it does not offer explanations for its lines of reasoning (although Leith intends, in the future, to add this facility to his system). More importantly, E.L.I. does not reason with legal experts' heuristic knowledge. The domain of application of E.L.I. is part of the law of the United Kingdom relating to supplementary benefits, chosen because of its simplicity which allowed Leith (not himself trained in law) to "become 'expert' in it." The system was not constructed, therefore, with the assistance of a legal expert, there could not have been any inclusion of experts' heuristics, and this factor might incline us to doubt whether the designation "expert system" is appropriate. Moreover, if a non-lawyer could, in a fairly short period, develop expertise in an area of law, then we

¹⁵ In a sense, the forerunners of A.I. knowledge-based systems in law (see below) are the computer-aided instruction in law systems, by means of whose programmed instructional techniques, it is said that "the computer can track a student through the process of analysing and solving problems." See Roger Park and Russell Burris, "Computer-Aided Instruction in Law: Theories, Techniques and Trepidations" in *American Bar Foundation Research Journal*, Winter, 1978, No. 1, pp.1-50, at p.42. While these C.A.I. systems can be regarded as bridging the conceptual gap between database and knowledge-based systems (see below) it is, without doubt, the techniques of A.I. that provide the most promising means of developing thoroughgoing knowledge-based systems in law.

¹⁶ See "Cautionary Notes on Legal Expert Systems" in *Computers and Law*, No. 40, May 1984, pp.14-16.

might justifiably query whether that chosen area is indeed a suitable domain of application. For the chosen legal domain ought to be one whose problems do indeed require expertise (normally acquired over many years), and not relatively brief research, for their resolution. This is not to belittle Leith's achievements, for he was clearly working with limited resources. Where possible, however, legal knowledge engineers should strive to consult extensively with legal experts, and pay heed to the admonition expressed in *Building Expert Systems*: "[it] is very easy to be deluded into thinking one knows a great deal about the domain" but "(r)emember: the expert became one only after years of training and experience."¹⁷

It is clear, however, that when fully operational expert systems in law of the type envisaged above are developed (as seems likely) then the output of these systems will be of a very different nature to that of the legal information systems mentioned at the start of this paper. In truth, we might question whether these latter machines do indeed offer us "information" about the law. Much confusion in this field, as indeed in many others, has been occasioned by the ambiguity of the term information, a concept in relation to which two radically diverging analyses are often offered by information theorists.¹⁸ On one account, information can (logically) come about only subsequent to the operation of the interpretative processes of some cognitive agent on some more basic raw material. In law, Professor Bryan Niblett seems to defend this thesis.¹⁹ He contends that computerised legal information retrieval systems, such as LEXIS, are not, strictly, information retrieval systems at all. Rather, Niblett argues, these are "document" retrieval systems, because in any search session a user is provided with texts of possibly relevant documents and not with a solution to the problem that he is investigating.

Proponents of the other school of thought in information theory maintain that advocates of the first confuse the notions of information and meaning. If this conceptual error is corrected, they argue, then information can be regarded, in the words of Dretske, "as an objective commodity, something whose generation, transmission, and reception do not require or in any way presuppose interpretive processes." He concludes, then, that the "raw material is information."²⁰ This conception of information is favoured implicitly, in law, by all, like Lucien Mehl,²¹ who consider there to

¹⁷ *Op. cit. supra*, note 9 at p.165. This text is generally regarded as an excellent contribution to the field.

¹⁸ See generally Fred I. Dretske, *Knowledge and the Flow of Information* (1981). Also see Michie and Johnston, *The Creative Computer*, *op. cit. supra*, note 8, Chap. 6.

¹⁹ In "Expert Systems for Lawyers" in *Computers and Law*, *op. cit. supra*, note 14, p.2.

²⁰ *Knowledge and the Flow of Information*, *op. cit. supra*, note 18, p.vii and *passim*.

²¹ "Automation in the Legal World—from the Machine Processing of Legal Information to the 'Law Machine'" *op. cit. supra*, note 5.

be no attendant linguistic infelicity in the usage of the expression "legal information" in respect of the produce of LEXIS and other similar systems. In law, however, there is also a third camp, occupants of which seem content to wield the term information wildly and with little discretion.²² These commentators deploy the title "legal informatics" on all occasions, exercising it as a generic term for many activities involving the application of computer technology to the law. Thus, they seem to find no problems in the practice of referring both to systems such as LEXIS, as well as to systems that might actually solve legal problems, as "legal information systems." Yet this practice tends to obscure our vision of what systems have actually been designed to do, how, it is conceived, they should function as aids to the legal profession.

It would be advantageous for practitioners and theorists alike, because of the uncertainty of its range of reference, if the word information were to be banished from the vocabulary of all those who profess an interest in computer applications to the law. In its stead, it is submitted that a more appropriate distinction of law machines, based on a systems design approach, is between database systems in law and knowledge-based systems in law. Because the term information is so firmly entrenched in the minds of so many, however, by way of compromise, where it would be unavoidable to phrase it otherwise, we might distinguish also between legal database information systems and legal knowledge-based information systems. The former systems are designed to function as non-intelligent supportive components in the general legal problem-solving process, while the latter (which may embody or interface with the former), assist in the more specific interpretative processes requiring a level of knowledge normally associated only with intelligent human beings.

While it would be a premature, and indeed a misconceived, exercise to detail all the conceivable advantages of expert systems in law, one striking and direct consequence of their widespread use bears mention: these systems would provide the legal profession with the possibility of overcoming difficulties resulting from intense specialisation in the law. This phenomenon has itself been occasioned, amongst other factors, by the continual expansion of the Statute Books as well as by the growth in number of reported cases, as a result of which lawyers are now incapable of keeping apace with many legal developments. Despite the availability and considerable use of database systems in law, many lawyers are, it is undeniable, still heavily reliant on the resources of the legal expert and his ability, culled from years of experience in the field, to direct his specialist knowledge to given legal problems.

²² e.g. see the collection of articles in Constantino Ciampi (ed.), *Artificial Intelligence and Legal Information Systems* (1982). It should be noted, however, that the Italian term "informatica" means computer science or information science, which perhaps explains the Italian commentators' wide usage of the word information.

The general practitioner is less likely now, than in the past, to be able himself to offer counsel to his client and is becoming increasingly dependent on expert advice for problems beyond his range of legal knowledge. The capability of the legal expert to identify, classify and analyse the problem domain, then adopt an appropriate mode of systematic inquiry, to follow this up by skilful and relevant consultation, and then finally to formulate his opinion, having evaluated various alternatives, is indeed a valuable legal resource. This resource, often transitory, even volatile in nature, surely is worthy of nurture and preservation. Untimely departures of senior partners from law firms, of scholars from the groves of academe, or indeed of members of the judiciary from the Bench can, without adequate educational preparation, wreak havoc in given specialised fields of law. It may now be possible, however, by use of expert systems in law, to preserve indefinitely, and to put at the disposal of others, the wealth of legal knowledge and expertise of various experts, hitherto bestowed upon the legal world in transient and indiscriminate doses. More than this, a "law machine" may now be able to offer assistance of a quality possibly greater than that of any one individual human legal expert. In the next section, we shall mention various projects that have contributed to the possibility of the development of such machines.

IV

Buchanan and Headrick, in an influential paper published in 1970, were the first to consider, systematically, the possibility of using A.I. techniques to assist in the process of legal reasoning.²³ Since then, no more than 25 sustained research projects have been launched in this field, the most important of which shall be mentioned in this and the following sections.²⁴

²³ "Some Speculation about Artificial Intelligence and Legal Reasoning" in the 23 *Stanford Law Review* (1970), pp.40-62.

²⁴ Most of the projects noted here have been the subjects of many papers presented by the principal researchers at recent conferences. e.g. The Advanced Workshop on Computer Science and Law, at University College of Swansea, in September 1979, the proceedings of that workshop recorded in Bryan Niblett (ed.), *Computer Science and Law* (1980); The International Conference on "Logic, Informatics, Law," in Florence, Italy, in April 1981, the selected and edited proceedings of which presented in *Artificial Intelligence and Legal Information Systems*, op. cit. supra, note 22, and Antonio A. Martino (ed.), *Deontic Logic, Computational Linguistics and Legal Information Systems* (1982); The Sixth Symposium on Legal Data Processing in Europe, in Thessaloniki, in July 1981, the proceedings entitled *Artificial Intelligence and Linguistic Problems in Legal Data Processing Systems* (1981); Data Processing and the Law, in Leicester, 1982, proceedings in Colin Campbell (ed.); *Data Processing and the Law* (1984); and The 2nd International Conference on "Logic, Informatics, Law", in Florence, Italy, in September 1985 the pre-proceedings held in *Atti preliminari del II Convegno internazionale di studi su Logica, Informatica, Diritto* (Firenze, IBI, 1985). Many of the projects have been discussed in recent review articles. See, e.g. Garry S. Grossman and Lewis D. Soloman in "Computers and Legal Reasoning" *Trusts and Estates*, October 1982, pp.43-48, and in a slightly different article carrying the same title in *Computers and Law* No. 36, May 1983 pp.11-13, and Mark Morris, in "Emerging Computer-Assisted Legal Analysis Systems" *Brigham Young University Law Review* Vol. 1980 No. 1, pp.116-141, in which TAXMAN, the M.I.T. Project, JUDITH and ABF are discussed. Nicolas Bellord in his *Computers for Lawyers* (London, Sinclair Browne, 1983) pp.141-143, outlines TAXMAN and ABF as well as LEGOL. Carl deBessonnet's articles (*infra*, note 35) are excellent introductions to the general field. In addition to these review articles, in the actual research reports themselves, there are regular cross-references by the authors to the works of the others.

The most thorough and sophisticated contribution so far has been made by McCarty, whose TAXMAN project²⁵ (initiated in 1972, and now involving both TAXMAN I and II), concerns the development of a program, using classical A.I. tools, that can perform "a very rudimentary form of 'legal reasoning'" in corporate taxation law. Meldman also commenced his M.I.T. Project²⁶ in the early 1970s, the prototype of which engages in "legal analysis" in relation to the torts of assault and battery. (This system was partially implemented by King in 1976).²⁷ Two other significant efforts originating in that period are Popp and Schlink's JUDITH,²⁸ which operates on the German Civil Code, and Sprowl's A.B.F.,²⁹ a computer system that uses regulations to draft legal documents.

Substantial advances in A.I. led to the launching of many later projects: (1) Hafner's L.I.R.S.,³⁰ which adopts a knowledge-based approach to the retrieval of documents pertaining to the law of negotiable instruments; (2) Waterman and Peterson's L.D.S.,³¹

²⁵ The following are a selection of L. Thorne McCarty's relevant works: "Reflections on TAXMAN: An Experiment in Artificial Intelligence and Legal Reasoning" (1977) 90 *Harvard Law Review* 837; "The TAXMAN Project: Towards a Cognitive Theory of Legal Argument" in *Computer Science and Law: advanced workshop on computer science and law*, Swansea, 1979 *op. cit. supra*, note 24; "Some Requirements for a Computer-based Legal Consultant" in *Proceedings of the 1st Annual National Conference on Artificial Intelligence* (1980) pp.298-300; (with N. S. Sridharan) "The Representation of an Evolving System of Legal Concepts: I. Logical Templates" in *Proceedings of the Third Biennial Conference of the Canadian Society for Computational Studies of Intelligence* (1980) pp.304-311; "A Computational Theory of Eisner v. Macomber" in C. Ciampi (ed.) *Artificial Intelligence and Legal Information Systems op. cit. supra*, note 22; (with Sridharan) "The Representation of an Evolving System of Legal Concepts: II. Prototypes and Deformations" in *Proceedings of the Seventh International Joint Conference on Artificial Intelligence* (1981) pp.246-253; "Intelligent legal information systems: problems and prospects" in *Data Processing and the Law op. cit. supra*, note 24; "Permissions and Obligations" in Hansen (ed.), *Modelling Knowledge, Action, Logic and Norms COMPLEX* no. 8/85. (1985).

²⁶ See *A Preliminary Study in Computer-Aided Legal Analysis*, Report No. MIT/LCS/TR-157, and "A Structural Model for Computer-Aided Legal Analysis" *Rutgers Journal of Computers and the Law*, Vol. 6, 1977 No. 1, pp.27-71.

²⁷ *Analysis and KRL Implementation of a Current Legal Reasoning Program Design*, (Unpublished, May 20, 1976).

²⁸ "JUDITH, A Computer Program to Advise Lawyers in Reasoning a Case" *Jurimetrics Journal*, Vol. 15. No. 4, Summer 1975, pp.303-314.

²⁹ See "Automating the Legal Reasoning Process: A Computer That Uses Regulations and Statutes to Draft Legal Documents." 1979 *American Bar Foundation Research Journal*, pp.1-81, and "Automated Assembly of Legal Documents" in *Computer Science and Law*, *op. cit. supra*, note 24.

³⁰ See *An Information Retrieval System Based on a Computer Model of Legal Knowledge* (1981) and "Representation of knowledge in a legal information retrieval system" in Oddy *et al.*, *Information Retrieval Research* (1981), pp.139-153.

³¹ See *Models of Legal Decisionmaking Report R-2717-ICJ* (1981), "Rule-Based Models of Legal Expertise" in *Proceedings of the First Annual National Conference on Artificial Intelligence* (1980) pp.272-275, and "Evaluating civil claims: and expert systems approach" in *Expert Systems* (1984) Vol. 1, No. 1, pp.65-76. Perhaps more than any other work, Waterman and Peterson's LDS establishes the feasibility of constructing fully-fledged expert systems in law. Their system, however, is not itself an expert system in law designed to aid in legal reasoning. Rather, they use the techniques of knowledge engineering as a novel way of examining an aspect of the U.S. system of civil justice. In so doing, they have provided an addition to the methodological weaponry of workers in the fields of sociology of law, sociological jurisprudence and socio-legal studies. Their system, as they acknowledge, would require considerable refinement before it could help litigants in the process of legal problem-solving.

whose goal is to develop, using expert systems techniques, a rule-based computer model of experts' decision-making in the process of settlement in civil litigation; (3) The PROLOG Projects,³² the best known of which were developed at Imperial College, London University, where the researchers have translated parts of The British Nationality Act of 1981, and of various DHSS regulations, into a logical formalism which in turn can now be run on a general expert system shell; (4) Michaelsen's TAXADVISOR program,³³ which advises on federal tax planning, and runs on the expert system shell,³⁴ EMYCIN; (5) DeBessonet's CCLIPS (Civil Code Legal Information Processing System),³⁵ which is being developed using A.I. techniques, and one of whose goals is to codify "scientifically" parts of the Louisiana Civil Code; (6) Leith's E.L.I.,³⁶ which, as we have said, operates on welfare law; and (7) Gardner's project in Stanford University relating to offer/acceptance law.³⁷

Other related projects are LEGOL/NORMA,³⁸ carried on at the London School of Economics, SARA,³⁹ developed at the Norwegian Research Center for Computers and Law (NRCCL), and POLYTEXT/ARBIT,⁴⁰ conducted under the auspices of the

³² See Cory *et al.*, "The British Nationality Act as a Logic Program" (Unpublished, January 1984) and Peter Hammond, "Representation of DHSS Regulations as a Logic Program" in the proceedings of the conference *Expert Systems 83* held at Churchill College, Cambridge, December 14-16, 1983. Also see Sharpe, *Logic Programming for the Law* (June 1984).

³³ "An expert system for federal tax planning," *Expert Systems* Vol. 1, No. 2, October 1984, pp.149-167.

³⁴ An expert system shell is a ready-made inference mechanism upon which an expert system may be built. A shell is created by removing the knowledge from an existing expert system, and leaving the inference sub-system so it can be used for other problem domains.

³⁵ See *e.g.* "A Proposal for Developing the Structural Science of Codification" in *Rutgers Journal of Computers, Technology and Law* Vol. 8 (1980) pp.47-63; "An Automated Approach to Scientific Codification" in *Rutgers Journal of Computers, Technology and Law* vol. 9 (1982) pp.27-75; and "An Automated Intelligent System Based on a Model of a Legal System," *Rutgers Journal of Computers, Technology and Law* Vol. 10 (1984) pp.31-58.

³⁶ See "ELI: An Expert Legislative Consultant" presented at the IEE Conference on *Man/Machine Systems* UMIST July 6-9, 1982, Conference Publication Number 212, "Hierarchically Structured Production Rules" in *The Computer Journal*, Vol. 26, No. 1, 1983, pp.1-5; "Logic, Formal Models and Legal Reasoning" *Jurimetrics Journal* Summer, 1984 Vol. 24, No. 4, 334; "Cautionary Notes on Legal Expert Systems" *op. cit. supra*, note 16, and "Clear Rules and Legal Expert Systems" *Atti preliminari del II Convegno internazionale di studi su Logica, Informatica, Diritto op. cit. supra*, note 24, pp.381-397.

³⁷ See "The Design of a Legal Analysis Program" in *Proceedings of The National Conference on Artificial Intelligence* (1983) pp.114-118 and *An Artificial Intelligence Approach to Legal Reasoning* (Stanford University, 1984).

³⁸ For a general introduction and useful bibliography see R. K. Stamper *et al.*, "The LEGOL project since 1976" in *Computers and Law* No. 23, February 1980, pp.10-13. For NORMA, see Stamper, "A Non-Classical Logic for Law Based on the Structures of Behaviour" *Atti preliminari del II Convegno internazionale di studi su Logica, Informatica, Diritto op. cit. supra*, note 24, pp.609-627.

³⁹ See Mette Borchgrevink and Johs. Hansen, "SARA: A System for the Analysis of Legal Decisions," and Jon Bings "Deontic Systems, A Sketchy Introduction" in Jon Bing and K. S. Selmer (eds.), *A Decade of Computers and Law* (1980).

⁴⁰ Staffan Lof, *The POLYTEXT/ARBIT Demonstration System* (Stockholm, FOA Report C40121-M7, September 1980).

Swedish National Defence Research Institute. Moreover, two lawyers, Bellord of the United Kingdom, and Hellawell of the United States of America, have also written programs that are relevant in this context—ATAXIS⁴¹ and CORPTAX⁴² respectively. Finally, worthy of note are the general expert system shells that are currently available, of which ESP/Advisor⁴³ is an appropriate example: its designers claim that it is suitable for the handling of complex rules and regulations, and, moreover, some of its sample knowledge bases have law as their domain of application.

Despite growing awareness and interest in the application of A.I. to legal reasoning, and notwithstanding the above research projects, as we have already noted, there has not yet been developed a fully operational expert system in law that is of utility to the legal profession.

If we have regard to the collective achievements of the aforementioned projects, however, it can be seen that significant progress towards the construction of expert systems in law has been made (advances which have benefited immeasurably, it should be stressed, from inter-disciplinary activity). Indeed we can now reasonably assert, in terms of the necessary computational tools, such an enterprise (at least of limited scope), is technically feasible. For obvious practical reasons and also for the opportunity of less doctrinaire evaluation (a prevalent feature of many commentaries), it is now desirable that a fully operative and useful system is built—one of the objectives of our project currently being conducted at Oxford University (see Section VI).

Of fundamental importance for workers in this field (despite our present optimism) is the fact that, for almost 15 years now, inquiries into the possibility of knowledge-based computer-assisted legal reasoning have been undertaken and yet have yielded far fewer positive results than comparable efforts in other disciplines. It might seem intuitively obvious that this lack of success stems from the differences between the nature of legal reasoning and the nature of other enterprises such as diagnosing illnesses, mineral prospecting, and inferring chemical structures. The latter, we generally agree, are rooted, ultimately, in the empirically-based, causal, descriptive laws of the natural sciences, whereas legal reasoning involves the manipulation of the prescriptive laws of the legal order, discoverable, in the main, not from uniformities or patterns in the external world but through scrutiny of the formal

⁴¹ See "Tax Planning by Computer" in *Computer Science and Law op. cit. supra*, note 24, pp.173–182, and "Information and Artificial Intelligence in the Lawyer's Office" in *Artificial Intelligence and Legal Information Systems, op. cit. supra*, note 22, pp.241–249, and "Expert Systems"—Chapter 10 of *Computers for Lawyers, op. cit. supra*, note 24.

⁴² See "A Computer Program for Legal Planning and Analysis: Taxation of Stock Redemptions," 80 *Colum. Law Rev.*, (1980) 1362–98. Also by the same author see "CHOOSE: A Computer program for Legal Planning and Analysis," 19 *Columbia Journal of Transnational Law*, (1981) 339.

⁴³ See Goodall, *The Guide to Expert Systems* (1985).

sources of the law. No attempts have been made, however, to examine in detail this intuitive reaction to what is regarded by some as an "epistemological" issue.⁴⁴ This lack of interest in such theoretical matters is typified by the paucity of attention exhibited, in the writings pertaining to the projects referred to above, towards the relationship between jurisprudence and A.I./legal reasoning.

In the explanatory papers of LDS, ABF, POLYTEXT/ARBIT as in the writings of Bellord and Hellawell, there are no references to jurisprudence. In the commentaries of the M.I.T. Project, JUDITH, and LEGOL/NORMA, legal theory is mentioned but is not considered as a matter of central significance in relation to the respective enterprises. In short, with the exceptions of SARA,⁴⁵ Gardner's work and E.L.I. (and to a far lesser extent, TAXMAN), the relationship manifested in the literature between jurisprudence and the application of A.I. to legal reasoning has been unidirectional, that is, the projects constitute marginal contributions to, rather than exploitations of, the wealth of jurisprudential resources that are available and indeed invaluable for the would-be scholar or builder of expert systems in law.

In this connection, Professor Bryan Niblett has claimed that "a successful expert system is likely to contribute more to jurisprudence than the other way round."⁴⁶ Our research (see Section VI) and the remainder of this paper casts doubt on that suggestion. In any event, if the majority of the projects mentioned above are indicative of quality, then it is unlikely that many commentaries on expert systems will exhibit the analytical rigour and sophistication of argument that characterise today's major contributions to legal theory. More importantly, it is believed that in the first instance jurisprudence can and ought to supply the models of law and legal reasoning that are required for computerised implementation in the process of building all expert systems in law. If this be the case, it is difficult to imagine that any subsequent contribution of expert systems to jurisprudence could be of such import as to overshadow the latter's initial endowment and thereby vindicate Niblett's contention.

No doubt, it may well transpire that, in Niblett's words, "the value of an expert system will reside not in its conformity to some

⁴⁴ See Aaron Sloman, "Epistemology and Artificial Intelligence" in *Expert Systems in the Micro-electronic Age*, *op. cit. supra*, note 9, pp.235-241.

⁴⁵ SARA was developed by the Norwegian Research Center for Computers and Law (NRCCCL), a body which carries out exemplary inter-disciplinary inquiries into the computer/law interface. NRCCCL's research is exceptional amongst the projects discussed here in that we find permeating its works an acute awareness of the complexities of jurisprudence and its intimate involvement with the task of designing systems to assist in legal reasoning. Much of their work on legal reasoning and computers is based on the writings of the Norwegian legal theorists Torstein Eckhoff and Nils Kristian Sundby. See *e.g.* "Computers, Discretion, and Legal Decision-making in Public Administration," "SARA: A System for the Analysis of Legal Decisions", and "Deontic Systems, A Sketchy Introduction" in *A Decade of Computers and Law*, *op. cit. supra*, note 39.

⁴⁶ "Expert Systems for Lawyers" *op. cit. supra*, note 14, p.3.

jurisprudential theory,”⁴⁷ if by this he means in conformity with a pre-existing theory, such as that of Hart, Dworkin, Finnis or Raz. It is beyond argument, however, that all expert systems must conform to some jurisprudential theory because all expert systems in law necessarily make assumptions about the nature of law and legal reasoning. To be more specific, all expert systems must embody a theory of structure and individuation of laws, a theory of legal norms, a theory of descriptive legal science, a theory of legal reasoning, a theory of logic and the law, and a theory of legal systems, as well as elements of a semantic theory, a sociology and a psychology of law (theories that must all themselves rest on more basic philosophical foundations).⁴⁸ If this is so, it would seem prudent that the general theory of law implicit in expert systems should be explicitly articulated using (where appropriate) the relevant works of seasoned theoreticians of law. Perhaps one reason that there is, as yet, no successful system is that the vast corpus of apposite jurisprudential material has not yet been tapped in the construction process.

It has been naïve to suppose, as we shall see in the next section, that computer scientists could talk unobjectionably and unassailably of issues such as representing legal knowledge and legal inference procedures. These are highly complex matters of jurisprudence that require the attention of workers of that field. It is submitted that we now have sufficient experience of the general field of A.I. and legal reasoning for the immediate commencement of a systematic jurisprudential inquiry into the various stages of legal knowledge engineering and expert systems in law together with the development of a compatible theory of law, to the extent that such a theory is required in this context. One of the principal goals of our research is to make such an inquiry and develop such a general theory.

The cynical critic of jurisprudence would probably retort, in response to the above proposal, that there is a degree of disagreement and dissent so great between legal theorists themselves that no points of contact between their competing theories could possibly be located and, therefore, legal theory has little to offer for the purposes suggested above. However, it is submitted that the divergence of views within jurisprudence has been unrealistically accentuated by the typical foci of inquiry, in that legal theorists tend to concentrate on the inherently contentious issues while ignoring “straightforward” matters (which themselves may indeed raise insurmountable difficulties for the less capable). There may very well be consensus over many jurisprudential questions that

⁴⁷ *Ibid.*

⁴⁸ For a more detailed account of some of these theories, see Gold and Susskind, “Expert Systems in Law: A Jurisprudential and Formal Specification Approach” in *Atti preliminari del II Convegno internazionale di studi su Logica, Informatica, Diritto op. cit. supra*, note 24, pp.307–309.

has remained unarticulated on grounds of it being simplistic or mundane. Indeed, it may be in virtue of this presupposed, unifying substratum of concordance that dialogue between the various schools has been possible. For instance, theorists may all agree on the forms of legal argument that are both possible and desirable in the clearest of cases. This unanimity may not be apparent from the literature because "hard cases" and not crystal "clear cases" have invariably been jurists' object of study.

If there is such a concurrence of approach in relation to legal reasoning as well as to legal theory in general, then it is a model culled from that harmony that should be implemented in expert systems in law. If there is not, and if these conflicts affect the expert system enterprise, then a model that clashes as little as possible with the ruling theories should be developed. It is currently being endeavoured to determine if a consensus theory of law (albeit of mundane and limited application), can be propounded. (It would be unnecessary, of course, to repeat such exegeses in respect of all systems in the future if these were all built in accordance with the principles offered in our initial theoretical exposition).

V

The need for jurisprudential involvement in this field can be appreciated more fully on careful consideration of the various approaches that have thus far been adopted in the design of A.I. systems in law, in relation to the three major research issues in expert systems that were identified in Section II of this article—knowledge acquisition, knowledge representation and knowledge utilisation.

Most A.I. theorists argue that knowledge acquisition, the process by which domain specific expertise is extracted from the domain specialist(s), is the major remaining obstacle to be tackled by expert systems research workers.⁴⁹ However, with the exceptions of the commentaries on ABF, in which Sprowl proposes an interesting method of acquiring heuristics, (and including them in a system) and on LDS, none of the projects that we have noted even approach this hurdle, still less attempt to negotiate it. Waterman and Peterson recognised this lack in their earlier work⁵⁰ and suggested techniques that might be used to remedy the shortcoming in their later research. While it seems that they did indeed conduct far more extensive interviews with experts in their subsequent studies, unfortunately we are not told a great deal about the techniques they used, as this was beyond the scope of their paper.⁵¹

Popp and Schlink also conjectured that their future systems might include heuristic rules. While Bellord and Hellawell are, as it

⁴⁹ See, e.g. *The Fifth Generation*, *op. cit. supra*, note 6, p.75.

⁵⁰ See *Models of Legal Decisionmaking*, *op. cit. supra*, note 31, Chap. 4.

⁵¹ See "Evaluating civil claims: and expert systems approach" *op. cit. supra*, note 31.

were, their own experts, they too offer little guidance to those who are keen on building expert systems in law but who recognise that they will need to extract the necessary expertise not from their own experience but from that of others. In general, the systems that have been developed to date have minimal heuristic content and no methods have yet been suggested that might eliminate this deficit. The knowledge represented in the systems usually consists of restructured statutory source material (case law has received far less treatment), and even in the statutory domain the researchers remain unsettled over whether superficial coverage of an extensive legal domain should be attempted, as in LEGOL/NORMA, or whether intensive coverage of a far more restricted area is more effective as in, say, the M.I.T. Project.

This last knowledge acquisition related issue is not problematic, however, if the characterisation of expert systems in law suggested in Section III of this paper is adopted. For in accordance with that analysis, there seems little doubt that intensive coverage of a small legal domain is preferable to superficial coverage of an extensive area of law. This is so because expert systems in law ought to be designed to replicate legal experts, the knowledge represented, therefore, necessarily being of a depth, richness and complexity normally possessed by such a human being. We would, of course, hesitate to call those persons who have a large but nonetheless shallow familiarity with the law "experts." This last matter aside, however, the problems of legal knowledge acquisition remain substantially unanswered.

Most of the projects mentioned above are chiefly concerned with legal knowledge representation. This, in our opinion, is the central issue of the study of legal knowledge engineering, a conclusion that is apparent on reflection on the differences between database and knowledge-based systems. In the full-text species of the former, the formal legal sources are stored in the computer memory in computer-readable format and are retrieved by the user as documents identical in content to the printed statute books and law reports of conventional law libraries. The legal data is not interpreted for this purpose, but is simply fed into the computer as the raw material of the process of legal reasoning. In knowledge-based systems in law, in contrast, these sources must be represented that is, restructured so that they can be stored in the memory and utilised in the reasoning process. The activity of legal knowledge representation, therefore, involves the operation of interpretative processes whereby the legal data of part of a legal system, valid at one particular point in time (that is, the legal data of a momentary legal system)⁵² is scrutinised, analysed and eventually reformulated in a fashion that is both faithful in meaning to the original source

⁵² See Joseph Raz, *The Concept of a Legal System* (2nd ed., 1980) pp.34-35; Carlos Alchourron and Eugenio Bulgin, *Normative Systems* (1971) pp.88-89 and J. W. Harris, *Law and Legal Science* (1979) pp.42-43, and pp.49-50.

materials and that allows for the requisite transparency and flexibility of expert systems in law.

Many different computational methods have been used to represent legal knowledge. In TAXMAN, Hafner's LIRS, the M.I.T. Project, and in King's implementation in KRL, for instance, the knowledge is represented in semantic networks, using frame-based computer languages. In LDS, JUDITH, ABF, the PROLOG Projects and in the programs of Bellord and Hellawell, in contrast, the knowledge base consists of a system of rules. These rule-based systems themselves differ. For example, in LDS, a generalised, all-purpose language, ROSIE, was used, whereas in the PROLOG Projects, a logic-based language, PROLOG, was deployed. As distinct from both of these "classical" A.I. implementation environments, for JUDITH, the science-orientated high-level language, FORTRAN, was chosen, while Hellawell opted for BASIC. The importance of adopting a suitable method of knowledge representation cannot be over-stated. For the efficiency of the system depends largely on this matter. In this connection McCarty has argued that: "the most critical task in the development of an intelligent information system, either for document retrieval or for expert advice, is the construction of a *conceptual model* of the relevant legal domain."⁵³ He calls for the development in law of "deep" systems akin to that of the glaucoma diagnosis expert system, CASNET, in which the disease is represented as a dynamic process structured as a network of causally connected pathophysiological states, in contrast to the "shallow rule-based" MYCIN which contains no internal representation of the disease process. Whereas TAXMAN aspires to the CASNET mode of representation, McCarty claims that Sprowl's ABF and Hellawell's CORPTAX can be likened in this respect to MYCIN.

However, no thorough examination of the relative merits of all the various approaches to the representation of legal knowledge has yet been attempted. It might be thought that this is simply a matter for computer scientists to work out. Yet that view reflects a misunderstanding of the enterprise of representing knowledge of the law, as it is quite clear that the fundamental issues involved here are jurisprudential. The object of the exercise is to describe the law in a fashion that can suitably be embodied, together with the experts' heuristics, in the knowledge base. The activity of describing the law while remaining faithful to its meaning has received considerable attention from eminent legal theorists. We need, as Dworkin has admitted, "a strategy of exposition"⁵⁴ and where better to initiate our search for that strategy than, say, the writings of Kelsen and Harris on legal science, Bentham's and

⁵³ "Intelligent legal information systems: problems and prospects" *op. cit. supra*, note 25, p.126 (original emphasis).

⁵⁴ *Taking Rights Seriously* (1977) p.75.

Raz's theories of the individuation of laws, and the studies of Ross, von Wright, Alchourron and Bulygin on normative discourse?⁵⁵

It would be bold to question the relevance of the works of Hans Kelsen who in the preface to his *General Theory of Law and State* states that he intends to provide the legal scientist with the "fundamental concepts by which the positive law of a definite legal community can be described." Kelsen's general theory of law must be pertinent for theorists of legal knowledge engineering for its aim is said to be "to enable the jurist concerned with a particular legal order, the lawyer, the judge, the legislator, or the law-teacher" and, we may not unreasonably infer, the legal knowledge engineer, "to understand and to describe as exactly as possible his own positive law."⁵⁶ When we "describe" the law in a computer programme, we will be engaging, as Alchourron and Bulygin put it, in a "reformulation,"⁵⁷ or, as Golding suggests, in a "rational reconstruction,"⁵⁸ of an area of law, and the comments of these theorists on these matters cannot sensibly be ignored. Likewise, with regard to the principles in accordance with which we may divide up our formal legal sources, surely we must pay heed to the limiting and guiding requirements with which Raz furnishes us for this purpose.⁵⁹ Moreover, once we have individuated our legal rules, we must then decide upon their precise structure for representational purposes. This is no easy task, for as Harris has said, "(t)he law does not announce, on its face, into what units it can be most usefully split up."⁶⁰ We noted previously that many researchers in A.I./legal reasoning (for example, Waterman and Peterson, Popp and Schlink, and Sprowl) represented the law as a system of rules. Laying aside the obvious jurisprudential difficulties involved in this process,⁶¹ it is striking that the internal structures of the rules represented in the respective systems are crude in comparison to, say, the components of laws that Ross and von Wright identify.⁶² Again, to disregard these theorists would be folly indeed.

⁵⁵ See, e.g. Hans Kelsen, *General Theory of Law and State* (1945) and *Pure Theory of Law* (1967), Harris, *Law and Legal Science op. cit. supra*, note 52; Jeremy Bentham, *Of Laws in General* (1980 ed. H. L. A. Hart), Raz, *The Concept of a Legal System op. cit. supra*, note 52; Alf Ross, *Directives and Norms* (1968), Georg Henrik von Wright, *Norm and Action* (1963), and Alchourron and Bulygin, *Normative Systems op. cit. supra*, note 52.

⁵⁶ *Op. cit. supra*, note 55, p.xiii. See also Harris, *Law and Legal Science op. cit. supra*, note 52, *passim*.

⁵⁷ *Normative Systems, op. cit. supra*, note 52, p.71.

⁵⁸ M. P. Golding, "Kelsen and the Concept of 'Legal System'" 47 *Archiv Fur Rechts und Sozialphilosophie* (1961) 355.

⁵⁹ *The Concept of a Legal System, op. cit. supra*, note 52, pp.140-147.

⁶⁰ *Law and Legal Science, op. cit. supra*, note 52, p.92

⁶¹ The question of whether or not the law is exclusively a system of rules is central to the Hart/Dworkin Debate. See, e.g. *Taking Rights Seriously, op. cit. supra*, note 54. Chaps. 2 and 3.

⁶² See *Directives and Norms, op. cit. supra*, note 55, Chap. V, and *Norm and Action op. cit. supra*, note 55, Chap V.

Not all legal theorists, of course, agree over the manner in which we ought to describe, individuate and structure the law. In this respect, Honoré argues that “(t)here is no theoretical way of settling the form, identity or individuality of laws other than to scrutinise them as they appear in professional discourse. To suppose otherwise is to become the victim of a strange form of analytical metaphysics.”⁶³ However, having surveyed the relevant jurisprudential literature and having noted both the concordance and dissent, we shall surely then be better equipped to discuss with computer scientists how we might build our knowledge base. In that way, we will be able to remove the law from the Procrustean bed into which many computer scientists have remorselessly thrust it in order that they might demonstrate the versatility of their favoured computer programming languages.⁶⁴ Furthermore, with our models of law drawn from legal theory, we shall then also be in a position to consider the possibility, desirability and indeed the necessity of following McCarty’s claim regarding “deep conceptual models” and expert systems in law.

To turn now to our third research issue: the challenge of designing the inference procedures of an expert system in law, the problem of legal knowledge utilisation, raises interesting questions for the legal knowledge engineer. Commentators Grossman, Soloman and Morrise⁶⁵ all place great emphasis on the distinction between deductive and analogical approaches adopted in the projects—a confusion that obscures the actual jurisprudential orientations and functions of the systems. For it is misleading to categorise TAXMAN and the M.I.T. Project as analogical systems. McCarty does not stress in any of the papers cited previously that either TAXMAN I or II are to be conceived as systems that reason by analogy. Moreover, Meldman’s definition of “legal analysis” together with his emphasis that his model simplifies the notion of analogy,⁶⁶ imply that he, too, would be reluctant to characterise his system as predominantly an analogical one. (King’s implementation of the M.I.T. Project, on the other hand, is principally concerned with analogy.)

Bearing in mind the top-down pattern matching technique used in TAXMAN II, the syllogistic instantiation of the M.I.T. Project, the forward-chaining of LDS and the backward chaining of both JUDITH and ABF, it seems that the distinguishing characteristic of all these pre-eminent systems (and indeed the others) is their

⁶³ “Real Laws” in Hacker and Raz (eds.), *Law, Morality and Society* (1977) p.100.

⁶⁴ Some of the workers on the PROLOG Projects, for instance, were, in a sense, committed to the use of the language PROLOG prior to the selection of the law as an apposite domain of application. The goal of some of their projects, then, was to represent selected areas of law in PROLOG come what may!

⁶⁵ In “Computers and Legal Reasoning” and “Emerging Computer-Assisted Legal Analysis Systems” respectively, *op. cit. supra*, note 24.

⁶⁶ “A Structural Model for Computer-Aided Legal Analysis” *op. cit. supra*, note 26, p.67.

dependence on deductive inference procedures. In consequence, all the objections to deductive legal reasoning that pervade the jurisprudential literature seem to be germane to current research projects in this field. While it is beyond the scope of this paper to examine in detail the various arguments that are normally marshalled in opposition to the notion of deductive legal reasoning, it is instructive nonetheless to consider several of them very briefly so that we may see their manifest implications for the activity of building expert systems in law.⁶⁷

One argument, The Argument from Truth Value, holds that the application of the laws of logic to the laws of the state is precluded because of the normative nature of the law. Because legal norms lack truth value, it is argued, they cannot be related to the facts of case by the logic of theoretical reasoning, that is, reasoning about what is the case.⁶⁸ One reply to this argument involves the development of a logic of norms, or a deontic logic thereby allowing for deduction within a different logical calculus.⁶⁹ If it is believed that this is the only satisfactory retort to The Argument from Truth Value, then it follows that the inference procedures used in the inference engine of all expert systems in law must be based on some form of deontic logic.

Another important objection to deductive legal reasoning seems to impose limits on the range of problems that expert systems in law can solve. This challenge is The Argument from Open-Texture, introduced to legal theory by H.L.A. Hart.⁷⁰ As a result of the semantic indeterminacy⁷¹ of the natural language in which the law is necessarily couched, deduction in law is possible, on the Hartian appraisal, only in the solving of "clear cases" in law, that is, he says, "those in which there is general agreement that they fall within the scope of a rule."⁷² Once more, jurisprudence seems to be of central importance, for we can expect in advance, if we accept Hart's analysis, that all expert systems in law whose

⁶⁷ There are many other objections to deductive legal reasoning other than those mentioned in the text. Some theorists have argued, for instance, that the process of selecting legal rules cannot be undertaken deductively. See e.g. Gidon Gottlieb, *The Logic of Choice* (1968), p.17. Wasserstrom has pointed out in *The Judicial Decision* (1961), that other critics have suggested that deduction in law presupposes the untenable notion of a gapless system of law (p.15). Others have said that deductivism precludes purposive interpretation and reasoning (e.g. Harris, *Law and Legal Science*, op. cit. note 52, Chap. 1) while still others have maintained that deductive judicial reasoning is conducive to concrete injustices, e.g. Gottlieb, *ibid.* p.18.

⁶⁸ This argument has been expressed most lucidly, although not, in the end, espoused, by H. L. A. Hart, See "Problems of the Philosophy of Law" in *Essays in Jurisprudence and Philosophy* (1983), p.100.

⁶⁹ See, e.g. Ross, *Directives and Norms*, op. cit. supra, note 55, Chap. VI, and von Wright, *Norm and Action*, op. cit. supra, note 55, Chaps. VIII and IX, and "Norms, Truth and Logic" in *Deontic Logic, Computational Linguistics and Legal Information Systems*, op. cit. supra, note 24.

⁷⁰ See the Introduction and Essays 2, 3 and 12 of *Essays in Jurisprudence and Philosophy*, op. cit. supra, note 68. Also *The Concept of Law* (1961), Chap. VII.

⁷¹ See *Normative Systems* op. cit. supra, note 52, pp.31-34.

⁷² "Problems of the Philosophy of Law" op. cit. supra, note 68, p.106.

inference procedures are solely deductive will function exclusively in the clear case domain, and will be of no aid in the solving of "problems of the penumbra."

Despite the apparent relevance of legal theory in this context, little cognisance of it has been taken by the leading researchers. Sprowl, for instance, alludes to no complications that arise from the use of deductive inference procedures in his work on A.I. and legal reasoning. From the thrust of their analyses, Meldman, Popp and Schlink are aware of several of them but recommend no counter strategies. McCarty, Waterman and Peterson, on the other hand, suggest how some of the problems arising from the open texture of legal rules might be resolved.

Perhaps the most telling objection to deduction in law with regard to all the projects is what can be termed The Argument from Particularity of Facts.⁷³ This asserts that the crucial, and non-deductive, stage in legal reasoning is that of classifying the particular facts of the case, a stage in which none of the current computer systems are of support. (All these systems implicitly defend what can be called a weak thesis of deductive legal reasoning, which asserts that it is possible, in some cases, to arrange the factual and legal premises in a way that will yield a conclusion that follows as a matter of logical necessity. A strong thesis would go further and claim that deduction can have a significant role to play in the process of actually selecting these premises.) Only Waterman and Peterson mention the difficulties of classifying the facts, but, even then, just in passing.

The Argument from Particularity of Facts is particularly persuasive if it is further accepted that most of the systems mentioned should be looked upon as intelligent knowledge-based, and not expert, systems in law, for the problems which the described systems are intended to solve do not clearly belong to the expert domain. In that event, the projects can rightly then be subjected also to The Argument from Unimportance,⁷⁴ which states that the (weak) deductive inference procedure involved is of little significance, for if the systems are operating in an area of law with

⁷³ O. C. Jensen, in *The Nature of Legal Argument* (1957) defends this argument: "the problem in a great number of cases may be expressed symbolically thus: all S is P, but the crucial question is just whether the conduct of the defendant (or of the plaintiff or of the accused) is S. In other words, the problem is one of classification rather than one of deduction" (p.16). And in respect of classification, Hart has noted that "(f)act situations do not await us neatly labelled, creased, and folded: nor is their legal classification written on them to be simply read off by the judge"—see "Positivism and the Separation of Law and Morals" in *Essays in Jurisprudence and Philosophy* *op. cit. supra*, note 68, p.63. See also M. J. Detmold, *The Unity of Law and Morality* (1984), p.15.

⁷⁴ Again, Jensen provides us with an instance of this argument: "if there is a process of logical deduction, it only occurs in the final stage [that is, after the selection of the legal and factual premises] and is so obvious that it need not be, and is not, given explicit formulation . . . the deductive process is such a subordinate part of the total argument that the precise determination of its nature is of academic interest only"—*The Nature of Legal Argument* *op. cit. supra*, note 73, p.16. See also Richard Wasserstrom, *The Judicial Decision*, *op. cit. supra*, note 67, p.23.

which general legal practitioners are conversant then they will have little interest in, and hence rare recourse to, a system that when given the facts simply applies the rules and draws the conclusions. Such lawyers, it is generally held, consider the problem in everyday cases to be that of determining just what constitute the facts of the instant case. If this is so, then designers of artificially intelligent systems must embrace one, or more, of the following strategies. First, they must build in the expert domain so that they might evade The Argument from Unimportance (and, also, avoid the criticism—previously directed at Leith—that their system is not indeed an expert system at all). Secondly, if they insist on constructing an I.K.B.S. in law, they must then provide sufficient and explicit heuristics and meta-rules (including rules of Evidence) within the system so that it assists in the selection of the operative facts, thereby both avoiding the charges of The Argument from Particularity of Facts and also, then, defending a strong thesis of deductive legal reasoning. Thirdly, they must adopt the second strategy in tandem with the first, that is, develop an expert system in law that also aids in the fact finding process. It is this last possibility that we are currently examining. We are also considering the possibilities both of allowing for open-texture and for reasoning by analogy by using the A.I. methods of reasoning with uncertainty, such as fuzzy logic and possibility theory, the implications of which have not yet been thoroughly considered in relation to expert systems in law.⁷⁵

And so despite their embodiment of many of the classical tools of A.I. and their concern with, or their designers' aspirations of, A.I., few of the current systems can be said even to approximate to expert systems of the sort with which our work is primarily concerned. We have already noted that the systems do not reason with heuristic, judgmental knowledge. Moreover, not all the systems are transparent, and even those that do offer explanations of their lines of reasoning (for instance, the PROLOG Projects and LDS), do so simply by regurgitating the rules that were fired. If a system is to replicate a human expert in law, it ought to provide more penetrating explanations than these, by clarifying the rules and, as Bellord realises, also by stating legal authorities for all material propositions advanced. Flexibility, in contrast to heuristics and transparency is well catered for in most of the major systems, particularly those whose knowledge is represented in semantic networks, and it is in relation to this that we can see the limitations of CORPTAX, the tax systems on sale in most leading department

⁷⁵ See L. A. Zadeh, "Fuzzy Sets as a Basis for a Theory of Possibility" in *Fuzzy Sets and Systems 1* 1978 pp.3-28, in which it is argued that the imprecision in natural language because of open-texture is mainly possibilistic rather than probabilistic in nature. As a result, Zadeh claims that it is possible to develop a universal language "in which the translation of a proposition expressed in a natural language takes the form of a procedure for computing the possibility distribution of a set of fuzzy relations in a database." (p.4). This would clearly be of interest to legal theorists.

stores and, as McCarty has noted,⁷⁶ the computer assisted instruction systems in law.

In the foregoing, the current projects were criticised, from a jurisprudential perspective, within a classification established by A.I. workers. This critique could be supplemented by examination of the projects, using legal theory as a point of departure. For instance, with regard to the function of legal reasoning, little mention is made in the research reports about whether the systems are intended to assist the user in, say, justifying a legal conclusion, persuading a given audience, predicting the ruling of a court, or in reconciling legal texts with certain values, all functions of legal reasoning that have been dealt with in the jurisprudential literature.⁷⁷ Whether the knowledge bases of the systems could be manipulated to fulfil all, some or none of these functions, we are not told. Most of the systems are designed for use by a lawyer. Again, whether the same knowledge base could serve in an expert system for other reasoning agents, by use of a distinct inference engine, is not revealed. This last possibility is of intense importance both to practitioners and theoreticians of the law. Indeed perhaps the most stimulating possibility in this field is that of developing a system that can be used by several classes of reasoning agent for their own very different and respective purposes.

VI

From this paper, it has emerged that there are many problems research workers in the field of expert systems in law must recognise and confront:

- (1) There are no commercially available, satisfactorily operating expert systems in both statute and case law, that have a high heuristic content and that are, moreover, at once transparent and flexible.
- (2) No guidelines have been offered by the cognoscenti in the field for those others who are interested in attempting to build such a system but who rightly have little desire to try to overcome problems that have already been successfully tackled.
- (3) There has been minimal jurisprudential input to the field, much of the work having been produced from a computational perspective.
- (4) The prototypes that are currently in operation cannot be instructed in natural language but require computer language

⁷⁶ "Intelligent legal information systems: problems and prospects," *op. cit. supra*, note 25, p.145.

⁷⁷ On justification and legal reasoning see, e.g. Neil MacCormick, *Legal Reasoning and Legal Theory* (1978); Harris, *Law and Legal Science*, *op. cit. supra*, note 52; and Wasserstrom, *The Judicial Decision*, *op. cit. supra*, note 67. On persuasion, see, e.g. Chaim Perelman, *Justice, Law and Argument* (1980) particularly Chap. 14. On prediction, see many of the works of the American Legal Realists, e.g. O. W. Holmes, "The Path of Law" in *Collected Legal Papers* (1920) p.167 and p.173. With regard to reconciliation, in civil jurisdictions, one of the functions of legal reasoning undertaken by jurists is considered to be that of reconciling the words of the authoritative texts with the values that the legal system in question is thought to embody.

or very restricted English input, and/or “yes/no” responses to questions asked of the user.

(5) There is little agreement over suitable terminology in the field, to the extent that researchers disagree over what constitutes an expert system in law properly so-called.

(6) No project report has ever addressed the possibility of computer-assisted operative fact finding.

(7) There have been no sustained attempts to employ the A.I. techniques associated with reasoning with uncertainty and, therefore, reasoning by analogy has not received detailed treatment.

(8) The possibility of expert systems interfacing with existing database computerised legal information retrieval systems has not been sufficiently examined.⁷⁸

The above eight problems will require decades of attention from the most skilful exponents in the field. It is the object of our interdisciplinary research project, currently being conducted at the Programming Research Group of the University of Oxford, to examine some of them, although problem 4, for example, is clearly beyond the scope of our study as it constitutes a major A.I. research topic in itself—natural language processing.

Our point of departure has been jurisprudence and a systematic inquiry into two of the stages of legal knowledge engineering has been made.⁷⁹ Having surveyed the relevant literature, we have developed methods of describing, individuating and structuring all laws (not merely statutory material) with a view to engaging in legal knowledge representation. With regard to legal knowledge utilisation, we have examined many commentaries on the notion of deductive legal reasoning in order to determine the utility and limitations of a deductive inference engine.⁸⁰ Thus equipped with coherent but nevertheless relatively informal models of laws and legal reasoning, we are now attempting to write formal specifications of these using appropriate mathematical tools.⁸¹ On completion of

⁷⁸ Because the legal knowledge base of any expert system in law is a representation of the chosen domain, it is desirable, and some would no doubt argue, necessary, that the user has direct access to the primary sources which have actually been represented. This could be achieved by interfacing expert systems in law with already existing database systems in law such as LEXIS. In no discussions of expert systems (or aspiring expert systems) in law, however, has this possibility been given serious consideration.

⁷⁹ The emphasis of our project is on legal knowledge representation and utilisation. Legal knowledge acquisition will not be given detailed and separate consideration, as we believe, in the legal domain, that this activity is inextricably related to legal knowledge representation. Any detailed study of legal knowledge acquisition and heuristics might best be undertaken by someone whose expertise is in the field of socio-legal studies.

⁸⁰ To date, the inference procedures chosen by knowledge engineers for expert systems (not in law) have been relatively simple, often based on classical first-order logic. Because such deductive procedures have been favoured (see *e.g.* Nilsson *Principles of Artificial Intelligence*, *op. cit. supra*, note 8), it seemed appropriate to start out investigation of legal knowledge utilisation with an examination of deductive legal reasoning.

⁸¹ On formal specification, see *e.g.* Bernard Sufrin, *Formal Specification of a Display Editor* (Oxford University Computing Laboratory, Technical Monograph PRG-21, June 1981): “The purpose of a formal system specification is to capture precisely and obviously

this task, we hope then to have at hand accurate and concise formal models that will be suitable for use in the construction of expert systems in law in any domain, and will therefore constitute the foundations of a shell for expert systems in law. To demonstrate our findings, we are endeavouring to build an expert system in law of the sort outlined in Section III of this paper. Our chosen domain belongs to Scottish Law of Divorce, whose sources are to be found both in statutes and judicial precedents. A portion of the Scottish Legal System is particularly appropriate, as the law in that jurisdiction manifests features of both civil and common law systems.⁸²

The findings, accordingly, are conceived as both a guide to anyone interested in building an expert system in law, as no such guide can presently be found, and, further, as a contribution to the study of legal theory as it is apparent that traditional questions of jurisprudence, and in particular, of analytical jurisprudence, are of relevance in this context. We will, moreover, as McCarty claimed in 1977, be able "to test out the implications of our theories" using the computer as "the most powerful tool for expressing formal theories and spinning out their consequences that has ever been devised."⁸³ There can be little doubt, then, that the successful construction of expert systems in law will be of profound theoretical and practical importance to all those whose concern is the law.

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the requirements of the system designer and his client—independently of whether the structures and functions embodied in it are immediately implementable . . . It should be an adequate basis both for judgements about the correctness of implementations of the system to be made, and for conclusions about system behaviour to be drawn independently of (and preferably in advance of) implementation" (p.1). Also see Gold and Susskind, "Expert Systems in Law: A Jurisprudential and Formal Specification Approach" *op. cit. supra*, note 48, pp.305–316.

⁸² Thus, our findings will be of relevance to the construction of expert systems in law in most, if not all, legal systems.

⁸³ "Reflections on TAXMAN: An Experiment in Artificial Intelligence and Legal Reasoning" *op. cit. supra*, note 25, p.840.

* Balliol College, Oxford. The author would like to thank Colin Tapper and David Gold for their helpful comments on earlier drafts of this paper. The facilities of the Programming Research Group of the University of Oxford are also gratefully acknowledged.