Explanatory rule maps

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The development of legal expert systems showed great promise up until the 1990s, but now it clearly has stalled at the Feigenbaum Bottleneck. A condition that would propel the technology is the publication by legislative and judicial lawmakers of rule maps with the same status as the explanatory memoranda that now accompany legislation. Lawmakers must accommodate the technology if society is to enjoy its benefits.

Justice Michael Kirby of the Australian High Court, has for some time prepared maps as part of his process of producing judgments. There is no reason why he should not attach these graphics to his judgments with obiter dicta concerning their use. A standard rule map may ultimately emerge through collaboration of the legal profession or by the evolution of best practice, in much the same way as standardised law reporting emerged in the last three hundred years.

Just as paradigms shift in scientific revolutions (Kuhn, 1970), so they must shift in jurisprudential revolutions. Technology has brought jurisprudence to such a revolution. Rule maps are a new jurisprudential paradigm required for the design of legal expert systems that automate legal intelligence.

Apart from assisting the development of expert systems technology in the legal domain, rule maps are also now essential for effective legal practice. The body of law has been formulated by many people over many centuries, and is now so massive and complex, it is well beyond the cognitive capacity of any individual. It is also holistic so it cannot safely be partitioned into separate automatable areas: in any particular case, divergent fields of law may converge. A legal expert must be prepared to think across several fields of law for the rules that are relevant in a given situation. Further, the body of law is plastic in the sense that it can be moulded and reshaped by lawmakers, according to the fashion suggested by legal experts.

Cognitive aids are now a necessity for effective development and implementation of the legal system. If we want an intelligent society, we must provide smart aids.

Edward Feigenbaum, who worked on the Stanford Heuristic Programming Project which constructed the first expert system, DENDRAL, in collaboration with the Stanford Mass Spectrometry Laboratory, reported to the Stanford Computer Science Department in 1977:

> ...the acquisition of domain knowledge [is] the bottleneck problem in the building of applications-oriented intelligent agents. (Quinlan, 1979 p.168)

The domain knowledge required for a legal expert system depends upon the type of system that is to be constructed. It is possible to build three types of legal expert system:

1. Black letter law systems which apply only black letter law.
2. Expanded black letter law systems which apply black letter law and whatever can be validly inferred from that law.
3. Critical expanded black letter law systems which apply black letter law, whatever can be validly inferred from it, and further critical glosses of the black letter law and/or of the valid inferences from it.

The initial bottleneck in the legal domain is not so much the acquisition of black letter law, for that is published as a discrete information entity. Rather, it is the subsequent standardisation and schematisation of the rules of black letter law to suit computation. Standardisation of the rules is a prerequisite for schematisation, and schematisation is determined by reference to the meaning of the standardised rules, relative to each other. Rule maps are a form of schematisation of standardised rules that clarify the relative meaning of rules. They permit the management of a system of rules for the purposes of design and programming of a legal expert system.

In 1979, two years after Feigenbaum identified the bottleneck, a pioneer of legal expert systems, Australian partner of Mallesons Stephen Jaques, Philip Argy, constructed an in-house Trade Practices Adviser, PNA 003, to assist him to screen cases referred to him by junior practitioners in the firm. He used a popular computer language at the time, BASIC, to program PNA 003, and no doubt designed the program according to a flowchart of routines and sub-routines that were the conventions of BASIC. The system implemented some of the black letter rules of the federal Trade Practices Act as well as some heuristic or screening practice rules of Argy's expertise. It was not long before PNA 003 required revision due to amendments of the legislation.

PNA 003 was small and served a limited achievable purpose. The construction of a large Trade Practices Adviser would not be affordable in terms of time and focus for the partner of a large legal firm. It becomes even less affordable when maintenance requirements are unpredictable. Irrespective of technology costs, there is little consideration by lawmakers of the cost in professional terms of massive development and change in the rules of law. Lawmakers may alleviate this cost if they provide rule

maps to assist understanding and implementation of changes.

During the 1980s, Peter Johnson and David Mead also learned the lesson that, for cost reasons, legal knowledge engineers cannot be expected to provide and maintain the rule mapping of black letter law. They, too, were early Australian pioneers of the technology. Their Social Security adviser, BED, constructed using PROLOG, was designed to assist welfare workers in advising on the eligibility of their clients for a federal pension or benefit under the Social Security Act.

BED was an impressive system. It went so far as to produce hard copies of appeal documents to assist eligible applicants in dealing with departmental rejections of their applications. Johnson was a lawyer who had worked in the Department and he was able to design BED according to appropriate practice heuristics. Just as BED was about to be released to welfare agencies, there were massive amendments to the legislation, making it immediately defunct. Since then, Johnson and Mead have been engaged continuously in the design and construction of various systems for federal departments.

The federal government might have learned from the British experience of a social security expert system during the 1970s. In 1972, the Lighthill Report advised the British government not to fund the development of artificial intelligence technology. It was thought to be impossible, due to the extensive complexity of human intelligence. However, David du Feu and Mike Adler of the University of Edinburgh received funding from the Scottish Office, the Inverclyde District Council and IBM for the Inverclyde Welfare Benefits Project to develop a Social Security program for public use. The system was soon constructed, using another popular programming language of the time, ANSI COBOL. It consisted of three programs: firstly, the validation program that checked user instructions for certain inconsistencies, gaps and difficulties, secondly, the calculation program that determined eligibility for benefits, and thirdly, the output program that produced a letter of advice to the user (Feu, 1980). In 1975, it was made available to the public for sixteen weeks during which time its effectiveness was studied. There was some indication that the cost of providing social security payments in the region would rise with prolonged public access to the artificial adviser. Public access to the system was permanently closed.

The Scottish experiment established that legal expert systems were largely a matter of program design and they could be very useful to lay people who are both subject to the law and the beneficiaries of the law. A primary role of government is to provide an effective legal system, one that is accessible, comprehensible and affordable to ordinary people; not one, such as we now have, that is slow, antiquated, cumbersome, unfathomable to most if not all people including lawyers, and user-unfriendly. Social respect for lawyers is at an all time low and that brings social disrespect for the law with its costs.

For many decades the Realist Schools of Jurisprudence have attempted to show that the legal system is a facade that disguises the exercise of power for covert purposes that suit individual vested interests. If the Realists are not correct, then there is nothing to prevent the provision of rule maps that will permit the development of transparent legal expert systems, underpinned by proper authority, for public use.

At the same time, the opportunities for private legal expert systems in the nature of expanded or critical systems, are sufficiently extensive for an entrepreneurial legal knowledge engineering profession, and for vitality in the legal system.

The river system is a form of rule map that was devised in the course of designing and constructing several prototype legal expert systems during the 1980s (Gray, 1997; www.csu.edu.au\faculty\commerce\account\3dlaw). It is derived from the nature of law itself but also employs as a metaphor, a commonly understood paradigm of a tributary structure.

River graphics represent rules of law that have been formalised as conditional propositions, i.e. as 'if (antecedent(s)) then (consequent)' statements. In the process of formalisation, a rule of law is delineated clearly as an order of antecedent(s) flowing like a stream to a consequent. Each antecedent and consequent is depicted graphically as a node, or small circle, with an identifying label. Nodes of a formalised rule are connected by lines with an arrow directed to the consequent node; the sequence of nodes represents the order of the antecedents in the formalised rule, and the arrow indicates the flow of the conditional relationship between antecedent(s) and consequent.

The figure below is a rule map that illustrates roughly the river system or streamlining of the tort of negligence.

Sometimes rules overlap because an antecedent in one rule is also a consequent in another rule. Thus, there is an antecedent 'duty of care' in the primary stream in the figure, that is prima facie necessary to establish the consequent of an actionable tort of 'negligence'; this antecedent is also the consequent in the secondary stream that has the several antecedents that are prima facie necessary to establish a duty of care.

To represent this sort of connection in legal information, formalised rules are graphically locked together at the point where nodes overlap. As illustrated in the figure, the interlocking of rule streams in this way creates a tributary or river system with an hierarchical structure. Thus, a consequent in one rule may join a second rule as one of its antecedents; it thereby joins the flow to the consequent of that second rule. Many rules may be interlocked, accordingly. However, no matter how large and complex, tributaries in a river system prima facie, consistently flow toward a final consequent or outcome. The rules that are represented in the figure are major rules that support the case for negligence. If a user satisfies all the prima facie necessary antecedents, then the final outcome of the user's case is that an actionable tort of negligence is established.

Sometimes more than one rule has the same consequent. This phenomenon is represented as a fan structure. For

instance, in the figure, there are three alternative ways of establishing proximity: by the physical, circumstantial or causal circumstances of the case. A meta-rule of tort allows a user to satisfy any one or more of the three antecedent tests. A fan structure represents a legal choice that must be exercised in accordance with the choice meta-rule.

A corresponding river system could be drawn for the defence of an action in negligence with the final outcome of no actionable tort of negligence. The theory of 3d legal logic explains a full rule and non-rule mapping for litigation management. (Gray, op.cit.) Maps may also be useful in commercial legal practice.

Where rivers are massive and complex, the hierarchical structure can be broken up to suit the cognitive capacity of ordinary individuals. A groups of rules that have flowed to a particular consequent can be treated as nested in the node of that labelled consequent. The group can then be accessed by a notional zoom into the node that contains that group. The notional zoom in a graphics program introduces the sense of 3d cyber space that captures the range of nesting that the depth of the rules requires.

The figure might be further detailed with nested rules and glosses that provide information about meta-rules, case authorities, statutory authorities, and presuppositions such as the dicta of Lord Atkins that uses the Christian commandment to love thy neighbour in order to found the negligence rules: *Donoghue v Stevenson* [1932] AC 562, 580.

The direction of flow in a river system provides a constant cognitive orientation for the purposes of large scale system design and programming management. River maps, like road maps, are familiar to ordinary people and are thus user-friendly. They can be used in a legal expert system to ensure that the law and its application is transparent to the lay user who is subject to the law. A river can be portrayed in a two-dimensional map or, a series of two-dimensional maps of the nesting. Street directories have already established symbolic conventions that could be followed by lawyers.

Rule maps should be cognitive aids for systematic legal practice and for the design of intelligent programs that could be constructed using any of the various programming tools that are available. They might be seen by computer scientists as the scheme for extended deductive arguments by way of application of the rules of law, or as the basis for designing a linear presentation of extended arguments that are a mixture of deduction, induction, predicate calculus, propositional calculus and various modal and non-monotonic reasoning. Yet at the same time they should be readily acceptable to ordinary thinkers who can follow the course of the rule streams as required in a procedural or strategic sense.

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