

NOTES • DISCUSSION • BOOK REVIEWS

The Role of Semantics in Legal Expert Systems and Legal Reasoning*

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1. Semantics is Central to Legal Reasoning

The consensus among legal philosophers is probably that rule-based legal expert systems leave much to be desired as aids in legal decision-making. Why? What can we do about it?

A bureaucrat administering some set of complex rules will ascertain the facts and apply the rules to them in order to discover their consequences for the case in hand. This process of deductive reasoning is characteristically bureaucratic.¹

If the client or subject of the decision, after he has checked the deductions, does not like the apparent consequences of the rules, he will question their interpretation. This is not a deductive process. He will examine the meanings of the words in the rules and those used to characterise his case, looking for adjustments that lead to a more favourable decision.

* This paper is based upon an invited contribution in May 1989 to the Conference on Legal Expert Systems organised by Prof. Enrico Pattaro as a part of the Ninth Centennial Celebrations of the University of Bologna. The contributions to this research programme by past and present members of the team are gratefully acknowledged, especially those by Peter Mason, Susan Jones, Clare Tagg, Sandra Cook, Martin Kolkmann and Liu Kechen.

¹ Weber's characterisation of bureaucracy is found in his *Essays in Sociology* where, in the English translation (1946), he says: "The fully developed bureaucratic mechanism compares with other organisations exactly as does the machine with the non-mechanical modes of production." This allows the administration to be performed "precisely, unambiguously, continuously and with as much speed as possible." He stresses the "objective [. . .] discharge of business according to *calculable rules*" which are "of paramount importance for modern bureaucracy."

If he turns to an expert for advice, he will call in a lawyer. Of course it may be worth rechecking the deductions but that is a relatively trivial part of his skill.² The lawyer applies his real expertise when he looks for variant reading of the rules, from those readings already made by the bureaucracy, to readings that might be made by a judge or tribunal. The dispute will only be resolved when the inclusion or exclusion of different rules has been settled and when the precise meanings of the included rules are agreed. Of course, the lawyer will also help his client by managing the procedural options in his favour. The procedures are also governed by rules and we have but another decision problem that divides into issues of bureaucratic choice and issues of interpretation. In his shoes, I should not be pleased with a lawyer who can reason about the deductive part of these problems but not the interpretive issues.

So-called "legal expert systems" that fail to handle the problems of interpretation do not deserve the epithet "expert."³ At best they can be called "bureaucratic expert systems," which is not to deny their potential value, only to recognise honestly their limitations.

We shall examine the extent to which expert systems can handle meanings, the root of all problems of interpretation. We need to uncover the semantics of the system, those principles, tacit or explicitly stated, that link the elements of a knowledge-base or the text of a body of rules to the features of the world they signify.

2. Misleading Metaphors

In the paper, "Expert Systems: Lawyers Beware!", Stamper (1988) draws attention to several metaphors regularly and unquestioningly employed in the discussion of expert-systems and the related fields of problem analysis.

1. *The conduit metaphor of language* treats words, expressions and sentences as carriers of meanings; detached from people, words go from place to place, or are "stored" in books and computers, "carrying" with them this abstract "content" we call "meaning." Whenever we talk about language this metaphor tends to be used (see Reddy 1979; Stamper 1985).

2. *The chemical engineering metaphor of data-processing* reveals itself in such commonplace descriptive phrases as "the extraction of information from data" and "the distillation of meaning from information." They lull one into thinking that data, information and meaning, like chemical materials, exist independently of their users.⁴

3. *The set metaphor of reality*, basic to the treatment of meaning in classical logic, regards the world as composed of individuals which can be assembled into sets, for example, the set of all red individuals.⁵ This metaphor is appropriate in the mathematical world of timeless abstractions but is not justified in the world of practical affairs where individuality and class membership can be open to dispute.

² In their book *How To Do Things With Rules*, Twining and Myers (1976), whilst acknowledging the importance of deductive reasoning in legal argumentation, nevertheless devote only six pages to that topic in their 270 pages volume.

³ See Dreyfus and Dreyfus (1986) for a thorough criticism of the misuse of the word "expert" in this context.

⁴ In the expert system field this metaphor is used. Michie and Johnston (1984) write of "a novel type of industrial plant, the 'knowledge refinery', which would take in specialist knowledge in its existing form . . . and turn out knowledge that is precise, tested and certified correct."

⁵ For examples of mathematical logic spilling over into non-mathematical domains see Whitehead and Russell (1910/27). Carnap (1942) is wholehearted in confirming this extension and Tarski (1965) in formulating it more precisely. One of the important points later in this paper is that to use mathematical logic in the domain of social and legal affairs requires justification of a non-mathematical kind.

4. The *correspondence metaphor of meaning*⁶ is also needed if one defines the meaning of "red" as that set of all red individuals – an idea that leads to making another metaphysical assumption about the existence of "possible worlds" without which some expressions ("your next contract") would have nothing to correspond with. This illustrates

5. The *platonic metaphor* which most of us accept readily enough as a result of the indoctrination we receive in our mathematics lessons. We do not balk at assuming the existence of worlds populated by abstract objects and mappings between them.⁷ Finally, bringing together all these metaphors, we have number 6.

6. The *information-processing metaphor of mind*, which equates minds and information processing devices, this helps us to accept the notion of knowledge as a saleable commodity packaged in an expert system.⁸

So commonplace are these metaphors that they seem like common sense. Even when someone's attention is drawn to them and their shortcomings have been acknowledged, they can be difficult to abandon. Always the question is asked: What can we put in their place? We cannot answer by offering to eliminate metaphors but by supplying others, as we shall explain below. In order to deal more successfully with social systems, a new kind of common sense, new metaphors, a new paradigm, can be introduced.

3. Propositional Logic as a Basis for Legal Expert Systems

To illustrate the semantic problems that arise in constructing legal expert systems, we shall examine rule-based systems built upon classical logics as their theoretical foundation. Equal attention should, perhaps, be given to systems based on some form of semantic net but their diversity and relative informality makes such systems difficult to target critically. In every case, the basis of the analysis should be to ask what is the underlying theory of meaning employed to relate the character-strings in the computer to the reality in which the systems serve their users. Logic-based systems are familiar enough to serve our purposes.

The simplest logical tool is Propositional Logic. The smallest meaningful character-strings are elementary propositions, P, Q, R . . . etc. Their meanings are not analysed any further than to determine whether they are true or false (t or f). So we can characterise the underlying semantics by a function, σ , which provides a truth value for each proposition.

$$\sigma(P) = t, \sigma(Q) = f, \sigma(R) = t, \dots$$

The logic allows one to construct compound propositions which have meanings, in the rudimentary sense of the function σ , computable from the truth-functional meanings of their constituents. Thus $Z = (P \text{ or } Q) \& R$ is a compound proposition for which

$$\sigma(Z) = t.$$

⁶ This is fully worked out in "Montague Semantics" to which Dowty *et al.* (1981) provide an excellent introduction.

⁷ For a discussion of the value of platonism as an aid to the mathematical imagination, see Davis and Hersh (1983).

⁸ Psychology needs metaphors in its search for a scientific understanding of the mind. Computer science provides the cognitive psychologist with a useful modern mechanical analogy, but the computer scientist cannot then use the presumption that minds are like machines to justify his quest for artificial intelligence.

Using Propositional Logic knowledge of the law can be stored in the form of rules such as

$$(PorQ)\&R \rightarrow S$$

so that, when the complex condition $(PorQ)\&R$ is met, the conclusion, S , can be asserted to be true also. This simple idea is just a re-writing of the familiar decision-table.

This kind of legal expert system is described by Susskind (1987). Here is a slightly simplified fragment from his analysis of the Scottish law of divorce.

legal production number 1	A&-B-[p]C
IF AND ONLY IF	
the marriage has broken down irretrievably	A
A.s.1(1) of The Divorce (Scotland) Act 1976	
AND NOT	
decree is to be withheld in respect of	
action under s.1(2)(e)	B
A.s.1(5) of The Divorce (Scotland) Act 1976	
THEN	
<i>the court may decide that [permission]</i>	
decree of divorce is to be granted	C
legal production number 2	(D&D')&(-E&-F) → [o]G
IF	
the defender has committed adultery	D
time limitation: since the date of the marriage	D'
A.s.1(2)(a) of The Divorce (Scotland) Act 1976	
AND NOT	
the adultery has been connived at in such a way	
as to raise the defence of lenocinium	E
A.s.1(3) of The Divorce (Scotland) Act 1976	
AND NOT	
the adultery had been condoned	F
A.s.1(3) of The Divorce (Scotland) Act 1976	
THEN	
<i>it shall be established that [obligation]</i>	
the marriage has broken down irretrievably	G

The basic structure here comes from Propositional Logic with some important additional features, in particular the deontic operators (permission and obligation) and the references to the relevant authorities, which we shall examine later. What does such a system "know" about the meanings of the words used in the law?

"Not much" must be the answer. Whoever assigns the truth-values to the elementary propositions makes the interpretations from which the consequences are mechanically determined. This kind of system has virtually no semantics, nor does it pretend to have any.

Its strength lies in the analysis of the constituent propositions and their organisation into rule structures that draw upon a mixture of statute law, case law and legal principles, supported by a clear statement of the authority for each element. In addition to the logical structure, such a system could provide an indexing scheme to a diversity of relevant material for use by the person who is deciding on the truth-values of the propositions.

Thus the semantic knowledge that is the most important part of the lawyers' expertise has to be left out of an expert system based on propositional logic because

such a logic has no structural machinery to embody semantic information except the truth values of whole propositions. Propositional logic does not recognise smaller units than whole propositions, certainly not individual words.

4. Predicate Logic for Expert Systems

Predicate Logic goes much further in the structures it recognises so it can exploit a more sophisticated semantics. Expert systems with this foundation appear to embody a substantial amount of knowledge of meanings. We shall examine the extent of this knowledge.

Predicate logic deals with the inner structure of each proposition. Each proposition has the simple grammatical structure

< subject > is < predicate >

the subject can be the name of a single individual and the predicate the name of a property, or the subject can be a pair, a triple, . . . of names of individuals and the predicate names a relationship between them:

John is a lawyer
John and Mary are married.

The crucial idea is that this logical system can distinguish not only propositions but also names of individuals and names of predicates. But what do these names mean?

In order that predicate logic should not be an abstract mathematical tool, we have to provide it with a semantics that can relate its symbolic expressions to entities in the world of practical affairs. This requires two basic assumptions. First an ontological assumption that the world is composed of individuals each of which can be identified; and also an epistemological assumption that we can know to which individual each name applies.

The semantics of predicate logic uses the idea of a truth function, as does propositional logic. The meaning of a proposition is given by its mapping onto a truth-value:

$\sigma(\text{John is a lawyer}) = \text{true}$

for example. But this truth value can be determined by referring to a more fundamental information. "John" is the name of an actual person (let us signify him by john) whilst "lawyer" is the name of the class of all individuals of that kind (let us signify this class of real individuals by LAWYER). The above proposition is true if and only if, referring to actual set membership, we find

john \in LAWYER

We do something similar to give a precise meaning to "married" by making it mean the set of all ordered pairs of individuals of the appropriate kind, called MARRIED. So

< john, mary > \in MARRIED

has to be tested to find the truth of the proposition "John and Mary are married."

Therefore, to know the meanings of the words in the formulae of predicate logic, we have to assume a knowledge of which individuals have the properties or fall into the classes named by the predicates, and which pairs, triples, . . ., of individuals are related in ways named by the higher order predicates. Each allocation of individuals to the relevant classes is called a "model."

The legal rules will be regarded as an axiomatic theory which can have any number of interpretations supplied by different models, that is, sets of individuals and their groupings into sets of individuals, sets of ordered pairs, sets of ordered triples . . . etc. This elegant mathematical theory can draw upon all the sophisticated machinery of set theory. In its richest form, initiated by Richard Montague (1974; see Dowty et al. 1981), it can handle the semantics of a logical formalism that approximates to natural language. How then does it serve our purposes in building legal expert systems?

5. Theoretical Semantic Problems

We have no need to look at the application of this kind of logic to law to see that it will raise some important semantic problems. Let us make a note of them before examining the additional problems arising in applications.

Propositional logic, which is a component of predicate logic, employs the concept of truth-functional semantics. It assumes that, at the level of whole propositions, you need only know the truth-values of each of them in any situation to know their meanings and the meanings of the logical expressions derived from them. This reliance on truth as a simple, basic concept for a theory of meaning seems to work in domains which are free from dispute (routine engineering, or routine natural science) where we can perform a reliable operation of checking the truth of a fact-statement. In the case of a legal dispute, truth is what we arrive at, not what we start from. In such circumstances the operational basis of the semantics must be different so that we can treat truth as the point we reach following negotiation (among the members of a jury or between the parties to a dispute).

Predicate logic uses the concept of an individual. Outside the mathematical domain, this concept is rather a sophisticated one which gives rise to the kinds of paradoxes that suggest we should be cautious about making it the basis of a semantics. What is and is not one and the same individual has been the subject of paradoxes since ancient times (the river of Heraclitus). The semantics of predicate logic does not elucidate these problems, is merely expects that the user has solved them to his own satisfaction. There are many important entities, such as water, gold and other substances that may be difficult to treat within the model of the world as a collection of individuals. Disputed identity may cause legal conflict, as in the case, for example, of the written-off car which appears on the road again – do we have one car that has been repaired or two cars, the second having been constructed from raw materials taken from the first when that one went out of existence.

The meaning of each predicate is defined as a set of individuals, or pairs of individuals, or triples . . . etc. If the membership of the set changes, then the meaning of the predicate changes, unless one is prepared to abandon the set-theoretic definition of identical sets in terms of the one-to-one identity of their members (by extension) in favour of an appeal to defining properties (by intension). But doing this requires a different ontological position in which the set is independent of the membership. The problem has to be solved: What happens as individuals are born and die? We have to live with an every-changing meaning of "person"! To escape from this dilemma, we can take as our defining set, the set of all persons past and future and in any imaginable world. (This illustrates the comfort to be derived from a faith in the Platonic Reality.) In its turn, this entails our treating all instants of time as identifiable individuals.

There is an escape. We can forget about a semantic theory that maps linguistic expressions onto sets of real objects. Instead we can put our trust in a purely syntactic theory. The logic contains rules of inference. These enable us, given one set of propositions (premises) to deduce, by mechanical operations on those premises, any

number of conclusions (theorems). To bother with what lies outside the system is regarded as irrelevant. This route simply dismisses semantics as not a real problem (Kowalski 1979, 9, for example) – a justifiable point of view if you are only interested in the closed world of deductive processes and have no wish to devote time to justifying their relationship with the untidy world outside.

To escape into the study of purely syntactic problems does not make the semantic problems disappear. On deciding to apply abstract logical formalisms to practical affairs, assumptions about their semantic justification should be made explicit. As we shall see, there is often too much reliance upon the users supplying the semantics intuitively.

6. A Fragment of an Expert System

To illustrate the semantics of expert systems based on predicate logic, a fragment of a rule-system developed by Sergot et al. (1986) will be examined. It deals with the British Nationality Act 1981, and it typifies the kind of system that interests us.

The first sub-section of the British Nationality Act 1981,

1.-(1) A person born in the United Kingdom after commencement shall be a British citizen if at the time of birth his father or mother is
 (a) a British citizen; or
 (b) settled in the United Kingdom.

They express as follows, captured by the knowledge engineer in a number of Horn Clauses in Prolog

x acquires British citizenship by section 1.1 on date y
 if x is born in the U.K.
 and x was born on date y
 and y is after or on commencement
 and x has a parent who qualifies under 1.1 on date y

x has a parent who qualifies under 1.1 on date y
 if z is a parent of x
 and z is a British citizen on date y

x has a parent who qualifies under 1.1 on date y
 if z is a parent of x
 and z is settled in the U.K. on date y

z is a parent of x
 if z is the mother of x

z is a parent of x
 if z is the father of x

A system based on such rules can either give us their logical consequences if we feed in the facts e.g.:

Matthew was born in the United Kingdom
 Matthew was born on 10 January 1987
 Ronald is the father of Matthew
 10 Jan 87 is after commencement
 Ronald was a British citizen on 10 Jan 1987

or, given a goal such as finding out whether Matthew has British citizenship or not, the system can generate the questions needed to elicit the facts before chaining forward to compute the answer.

Most of us would describe this kind of application of the law as a function of an ideal Weberian bureaucracy. Straightforward facts generate unequivocal consequences. The process does not employ much of a lawyer's powers of reasoning although the bureaucracy may employ lawyers to perform this kind of deduction, especially to deal with very complex and seldom used chains of rules. Normal legal practice could not be performed only using the skills of deductive reasoning; neither could real bureaucrats do their work using only such banal reasoning processes. What is missing?

7. Semantic Problems Arising in Expert Systems Based on Predicate Logic

The bureaucrat has to put the facts into words. Even when his job is limited to mechanical, deductive decision-making, he soon encounters some obvious semantic problems. For example, if I gave him the facts relevant to my son's claim for citizenship as I did above, then the system could not reason from those postulates. They would have to be revised as follows:

not:

Matthew was born in the United Kingdom

but, to match "x is born in the U.K.":

Matthew is born in the U.K.

not:

Matthew was born on 10 January 1987

but, to match "x was born on date y":

Matthew was born on date 10 January 1987

not:

10 Jan 87 is after commencement

but, to match "y is after or on commencement":

10 January 1987 is after or on commencement

not:

Ronald is Matthew's father

but, to match "z is the father of x":

Ronald is the father of Matthew

not:

Ronald was a British citizen on 10 Jan 1987

but, to match "z is a British citizen on date y":

Ronald is a British citizen on date 10 January 1987

Of course the system would not have been designed to accept the input in any form but rather to ask for the facts to be "filled in" using the formats prescribed by the analyst. This solution means that this system has its own private way of collecting relevant data – just the problem that caused so much trouble in the early days of data-processing when dozens of stand-alone applications could not exchange data. In administration this is a serious fault.

8. Semantics and Large Systems

The problems caused by inventing a private language for each application not only affects the exchange of data but it makes it impossible to integrate legal expert systems by the obvious, simple method of merging rules. This would not be a serious problem if different areas of the law could be placed in water-tight compartments, but as the law is a single fabric, this is a serious issue when considering strategy of developing integrated systems.

At the root of this problem is the fact that predicate logic is weak methodologically. Analysis of a legal text and its expression for manipulation in predicate logic does not elucidate meanings, but rather obscures them. Nothing in the structures distinguished by this logic will lead two different knowledge engineers to the same paraphrase of the original text. Thus, the same original concept appearing in two different pieces of legislation analysed by two different engineers will only result in the identical predicate expression by a happy accident. We should not have to rely upon such chance agreements to preserve semantic integrity across a growing corpus of legal knowledge-bases.

Returning to the example above, we can observe another semantic problem. The predicate names (in bold type) must have exactly the same form whoever uses them because they function as single symbols. A more honest representation of the above ten predicates created by the analyst would use single symbols, or at least strings that do not masquerade as natural language:

xAy for x **acquires British citizenship by section 1.1 on date** y
 xUy for x **is born in the U.K.**
 xDy for x **was born on date** y
 yC for y **is after or on commencement**
 xQy for x **has a parent who qualifies under 1.1 on date** y
 zPx for z **is a parent of** x
 zBy for z **is a British citizen on day** y
 zSy for z **is settled in the U.K. on date** y
 zMx for z **is the mother of** x
 zFx for z **is the father of** x

The analyst who ran out of symbols could use longer strings, following the general practice in programming. This simple change emphasizes that we should not forget the fact that the analyst invents a new, artificial language when he creates an expert system using a language such as Prolog.

9. The Humpty Dumpty Syndrome

These "fat predicates," the elongated symbols that look like natural language, are constructed by trial and error by the analyst.⁹ He invests them with meaning. The analyst behaves like Humpty Dumpty in *Alice Through the Looking Glass*, giving words and other symbols precisely the meanings he wants them to have. The Humpty Dumpty syndrome is not only a disease transmitted by Prolog, it infects virtually all computer applications. It has some serious consequences.

First, by actually allowing the analyst to invent an artificial language, over and above the already complex language of the law, we reduce the chance of anyone understanding correctly the contents of the "knowledge-base."

Second, "fat predicates" serve to deceive the naive customer looking for an expert system. He may imagine – as an unscrupulous expert system vendor may intend – that the computer understands the meanings of the natural language words. It does not. We should not hesitate to criticise a mechanical engineer who supplies cardboard boxes painted grey leaving the customer to assume that they are steel girders, so let us demand similar standards from the knowledge engineer.

Third, the analyst assumes that the original text of the statute contains a meaning which he has "captured" (note the metaphor) equally well in his formal version.

⁹ Sergot et al. (1986) explain and appear to recommend this procedure in the section entitled "Formalisation by Trial and Error."

Lawyers, however, take great care to preserve forms of words that have withstood the test of scrutiny by courts over many years. They will recognise the danger in this casual attitude towards language. The same problem will arise if the original text is analysed into its constituents by even the most sophisticated semantic analysis method, but, in this case, there is a reasonable chance that the analytical process will tend to improve the drafting of legal texts from a semantic point of view.

We have noted the ease with which semantic confusions can be introduced to the knowledge-base in this kind of system. What can we do to remove the potential confusions introduced by a dozen Humpty Dumpties working on different parts of a huge corpus of formalised law?

The only notion of meaning accessible to the computer depends upon the purely syntactic equivalence of one sign to another. Of course, the analyst working on a lengthy problem finds it difficult to remember the exact form of each elaborate predicate expression he has defined. Where we fear that several different formal predicates express the same legal concept, we might attempt to uncover these accidental semantic confusions by searching predicate strings for common terms. This cannot guarantee success. One can easily find paraphrases that contain no common significant terms! For example, the original

- x acquires British citizenship by section 1.1 on date y
- may appear elsewhere in the following guises
- x acquires British citizenship on date y by sect. 1.1
- British citizenship of x acquired on y under sub-section 1.-(1)
- x is a citizen from y by virtue of British statute 1981c61,1.-(1)
- x is a natural born Briton commencing on y (ref UK 1981c61)

Unfortunately, as one can see from the last version, paraphrases need not include any common term.

Clearly, this problem of matching different versions of what are supposed to be the same legal concept will give rise to errors and confusions when systems have to be extended and amended. It will prove an obstacle to the difficult process of unifying legal knowledge-bases created at different times by different analysts. And it will even obstruct the integration of the efforts of a team of analysts engaged on the same large legal domain.

Quite another attitude towards paraphrasing might be justified – why not admit different interpretations? Dealing with law in the European Community it may be wise to allow the same piece of text to be treated in several different ways in a knowledge-base, to take account of national differences of behaviour. Interpretations can be localised to individuals or to groups. Unfortunately, this logic has no place to record the agent providing the interpretation of the meaning of the text. Meanings, it seems, are assumed to belong objectively to the natural language text, and the analyst only has to perceive and record them in another, but formal language.

Paraphrasing problems are explained by the shallowness of the semantic analysis required for predicate logic. It is quite easy to shift between different forms when, with equal validity, one can accommodate a concept by treating it as a distinct individual, as the date is treated in

- x acquires British citizenship by section 1.1 on date y
- whilst it can also be incorporated into a prolix predicate, as in
- x acquires British citizenship at birth by section 1.1

This illustration demonstrates the looseness of the ontology behind predicate logic. What is deemed to exist or not exist is decided at the whim of the analyst!

One can only draw the conclusion that predicate logic, whilst being wonderfully rigorous from a syntactic viewpoint, is sloppy and informal semantically.

10. Predicate Logic Suits Bureaucratic Systems

Bureaucratic systems are expected to operate as impartial machinery giving effect to policies worked out by the political system where value-judgments are paramount. Logical systems devised to serve mathematics may suit the ideal bureaucratic system.

Legal systems are more than bureaucratic ones. They may give rise to systems of routine office work to take care of the commonest cases but the creation of the legal norms and their interpretation in the difficult cases involves the examination and re-examination of the values which the norms are supposed to embody. Differences of value-judgments become exposed as disputes about meanings. A logic for legal systems must give semantics pride of place.

Mathematics, the paradigm of deductive reasoning, despite the claims made on its behalf (Susskind 1987, 185), does not necessarily provide the ideal model for reasoning in the domain of practical legal and business affairs. A logic inspired by mathematics will take advantage of simplifications that have no justification in the world of human relationships.

Despite all the above noted objections to the rule-based expert systems built on the foundation of classical logic, they do have a place in the automation of routine administrative tasks defined by laws. I have no objection to such systems but I would hesitate to call them "legal expert systems" rather than "bureaucratic expert systems."

Why should we expect a logic devised by mathematicians for their work to transfer comfortably to the domains of law and other practical social affairs that do not share the special properties of timelessness, abstraction, precise formality, independence from human judgment, desires and intentional action? It seems to me potentially a poor candidate for expressing legal issues but, *faute de mieux*, people have embraced it too enthusiastically and quite uncritically.

"What can we put in its place?" you will rightly ask.

11. Escaping from a Misleading Paradigm

In a research project aimed at discovering ways of modelling organisations as systems of social norms,¹⁰ my colleagues and I have attempted to escape from the frame of reference within which classical logic was created. Leaving a familiar framework can be very difficult, especially if there does not exist a ready-made alternative. Sometimes even more daunting is the passionate, irrational opposition with which a new framework will probably be greeted, revealing that the underlying metaphysics of a formal system owes as much, perhaps, to blind faith as any religious fundamentalism!

This work on developing a legally orientated language, Legol, was conducted at the London School of Economics over many years but has now relocated at the University of Twente. Several versions of this language were formulated and implemented.

Throughout, the law itself acted as the main source of ideas. Instead of aiming to apply logic to the law, we hoped to explicate the logic of the law. Whereas classical logic embodies the structures observed in mathematical systems, the law (as ancient a discipline as mathematics) might be expected to have evolved very different structures. Instead of dealing with timeless abstractions for which no person is

¹⁰ A strategy which, we are pleased to note, Bob Kowalski's team has now embraced.

responsible, the law concerns a strict time-frame where specific people, as far as possible, are held responsible for the concrete events and actions to which its norms apply. This led us to incorporate into the formalism structures that require the analyst to take account of a number of features of obvious importance in every legal problem we had investigated. The result was an informal, partial answer to some of the questions about semantics raised in this paper.

This partial solution¹¹ can be illustrated using the same Nationality Act example. Our empirical work made it clear that the analysis would have to penetrate to the level of individual words or expressions that function as the semantic units in natural language. It was also clear that time had a special role; there was no point in treating it as either a class of individual instants or a class of intervals. Also, there had to be a place for the authority that determined the existence of every legally significant state of affairs. The result, from a semantic point of view, is indicated in the table below.

<i>Entity</i>	<i>Characteristic Antecedents</i>	<i>Identifiers/Existence StartFinish</i>
nation	name	
nation	" Britain "	< time > < time >
person	name	birthdeath
citizenship	"1981c61"	person, nation
	citizen, nationality	
citizenship	"1981c61ss1(1)"	person, nation
citizenship	"1981c61ss1(2)"	person, nation
territory	name	
territory	" United Kingdom "	< time > < time >
located in	?	person, territory
act name		
act "1981c61"		< time > < time >
commencement	"1981c61s53"	act
fatherhood	?	person.1, person.2
	father child	
motherhood	?	person.1, person.2
	mother child	
settled in	"1981c61s50"	person, territory

Most of this table corresponds to a schema (in database terminology) which specifies the universals or entity types, that is, the classes of particular instances. In bold type are a few particulars. Every particular has associated with it a period of existence and the corresponding universal can be annotated to indicate how the start and finish times should be selected (birth and death for a person, for example).

The *characteristic* can be name, in some cases, or it can be a criterion for the existence of a particular. For example, citizenship exists by virtue of a number of different criteria, giving rise potentially to a number of different meanings of the concept. In the cases of "located in," "fatherhood" and "motherhood" we do not know the criterion, and this is an indication that the analyst should clarify this point in order to complete his semantic schema.¹²

Identifiers are the names of the types of individuals being qualified or related by the entity. Later these were more accurately described as antecedents when they were generalised to be any other entity. The importance of antecedents is that their

¹¹ See Jones et al. (1979), Tagg (1979) and Stamper (1980) for accounts of Legol-2.0 and Legol-2.1, the latter having been demonstrated in the 1979 Symposium on Computers and Law at Swansea.

¹² Note how the syntax of this formalism guides the analyst.

co-existence was a necessary precondition for the existence of an instance of the entity, except in the case of what we call "things" which could have an independent existence. The antecedents also commonly have role names which can be inserted in the definitions, as above for citizen, nationality, father, mother, child.

This is not the place to explain the Legol language for manipulating these structures and for expressing norms. An illustration will be enough. It would not have been difficult to provide an infix notation that would have made the first subsection of the Nationality Act 1981 read as follows.

Citizenship of Britain of a person [criterion: 1981c61ss1(1)] starts when
the birth of that person occurs
after commencement of the British Nationality Act 1981c61
while his father is a British citizen or settled in the UK
or while his mother is a British citizen or settled in the UK

The words underlined are operators that function as logical operators that in every case take account of time. Some words here are just syntactic sugar and would be ignored by the interpreter. However, those words that appear in the table above can be manipulated as separate concepts (and so are in a sense "understood") by the computer.

This intermediate solution is full of defects. In particular, it does not function as a logic although it does allow the forward and backward chaining of rules that a legal expert system requires. In that respect it does not have the theoretical underpinning enjoyed by Prolog. Nevertheless, it has the advantage of taking care of some of the semantic problems catalogued earlier.

In particular

1. fat predicates disappear and the semantic units of the formalism are those of the natural language;
2. semantic analysis no longer depends totally on the analyst's skills in paraphrasing the original text;
3. indeed, semantic analysis is guided by the quite rich structure awaiting his results – each relevant word in the text generates a string of questions that must be answered about the start, finish, criterion, antecedents and role names;
4. accidental synonyms or multiple interpretations cease to be a danger because the arbitrary solutions that bedevil most systems specifications are greatly reduced, if not entirely eliminated when the level of analysis is reduced to the word.

Despite these advances, this intermediate solution fails to break away from the old, defective framework. It still assumes the existence of individuals although it does not force one to treat instants or intervals of time among them. It still adopts the stance that we can describe an objective reality using our language and so decide what is true and what is false.

Nevertheless, it is loaded with signposts directing us towards a new framework. For example,

- existence is clearly a candidate to replace truth as a primitive concept;
- the idea of a criterion suggests that each instance of anything existing has to be determined by an authority, either in the form of an agent or a norm;
- there appears to be a unifying structure that eliminates the distinctions between individuals and predicates, or particulars and universals;
- there seems no reason to treat norms as another kind of entity.

The signposts begin to make sense once one abandons the old metaphysical assumptions.

12. A New Framework

The goal is to create a logical language incorporating a theory of meaning appropriate for domains of practical human affairs. The work is not yet complete. At present the result is a formalism, capable of mechanical interpretation, and, we believe, capable of development into a fully functioning logical system despite its many rather unusual features. It has become convenient to employ two formalisms, one, still called Legol, for manipulating the knowledge-base and another, called Norma, for knowledge representation. Norma is an attempt to capture in a logical syntax what we have discovered about the structures underlying social and legal norms.

The theory has been developed through the analysis of very large numbers of legal problems and business information systems. This had led to the evolution of a method of analysis which has proved to be effective in designing systems that are cheaper to build and far cheaper to maintain than those developed using the conventional methodologies. This practical aspect of the work is emphasized in the Appendix to this paper where a concrete example is presented. This is also included in the hope that it will help the reader to follow some of the more abstract concepts introduced below.

The metaphysical assumptions on which Norma is based are radically different from those that seem tacitly to be adopted by builders of rule-based expert systems today. I hope that you will agree that they are not difficult to accept, indeed that they are less mysterious than the metaphysical assumptions upon which orthodox logics are based. In our view there is no need to depend on the notions of individuality, identity, truth, and possible worlds, for example. These are all very sophisticated concepts of which we are innocent at birth. However, we start our lives with a desire to act, and a rudimentary system of values that defines the boundaries between states of behaviour that we like and dislike. During our most innocent months of life, we live in the here-and-now and we act directly on the world; only later do we begin to construct realities distant in space and time, and learn to act indirectly through communication. That very simple beginning is also our starting point for constructing our new framework.

A belief in the existence of at least one agent (yourself) and his/her behaviour are the most basic ontological assumptions. We need symbols to represent these two kinds of things. Two epistemological principles govern the syntactic structure:

all knowledge entails a knowing agent

the agent only gains his knowledge through action.

The agent, an organism that has acquired (genetically, presumably, though it really does not matter how) a rich enough structure (an issue that can be examined later using the theory to be created) stands at the centre of reality. For the organism, reality unfolds through its action (see Gibson 1979; Michaels and Carello 1981). Each of us is responsible for the knowledge we have but the social system enables us to share our efforts and so live in a much richer reality. The concept of an agent can be extended to include groups, or social agents such as committees, teams, companies, nation-states even. Their collective behaviour is what we are interested in when we study norms.¹³

The idea of responsibility is basic. In the crudest sense of having to live with their consequences, the agent takes responsibility for its actions; by organising its behaviour system well, the agent has a better chance of surviving as an organism in the physical world or as a social agent in a social environment. In a more sophisticated way, responsibility arises in a human society as a result of the expectations produced

¹³ The whole social agent is much more than its individual membership because of the addition of its norms. Every norm exists in relation to a particular social grouping.

by the agents' intentional acts involving one another and the capacity of the social system to compel its members to endure the social consequences of their actions.

The two fundamental principles result in a syntactic structure that mirrors the form of every pattern of behaviour in the shape of well-formed-formulas (wff) having two components:

< agent > < behavioral invariant >

Such a formula we call a "realisation" because it represents a realised or actual state of affairs, here and now.

An agent that attains some behaviourally invariant state may be regarded as a modified form of agent which can enter as the agent expression into another realisation (wff). So we find the early concept of an antecedent in Legol incorporated into this language (for example, a state that has created an Act can then perform the behaviour it calls "commencement" in the example above). The logical operation of building a new pattern of behaviour on the foundation of its antecedents is represented by the concatenation of invariants:

Axy

where the agent, A, realising x, has become the agent (Ax) and so has been able to realise the dependent behaviour y. Because the existence of y can only occur during the existence of x, we call y the ontological dependent of x, its ontological antecedent.

What are these behavioural invariants? The easiest way of recognising them is by means of our natural language vocabulary. Most of our words (certainly our nouns, verbs, prepositions, adjectives, adverbs) are names of invariants. It may seem puzzling to treat the names of objects this way but just consider what you know about any ordinary object such as a cup. All your knowledge of a cup comes from what you *do* with it, or what someone else tells you about what he does with a cup. To speak of a cup is to speak of a repertoire of behaviour that the cup makes available – provided that you have the invariant cup, you have available to you all the things you can do with the cup.¹⁴ Vocabulary (rather neglected by linguistic theory (Aitchison 1987)) is thus linked to our collective choice of where we draw boundaries to mark biologically or socially significant shifts in the value of our behaviour. Words are names for zones in our behavioural space, zones where some important features are invariant.

To this, the most basic of the logic structures, ontological dependency, we add a number of logical constants to account for our ability to combine behaviour patterns at the same level. These are the analogues of the familiar operators *and*, *or*, and *not* of propositional logic with the important difference that they do not combine sentences but behaviours; one may do one thing *while* doing another, *orwhile* doing another, or *whilenot* doing another (notice that we cannot have negative actions, so *whilenot* is dyadic). The agent only exists in the present, but its present behaviour (overt and internal) can become extremely complex if it is to accommodate its beliefs about the

¹⁴ This repertoire of behaviour is associated with any number of amount of cups. Given an indeterminate quantity of cups, we can engage in the important and very basic behaviour of dividing them up and discarding part. This behaviour can continue until we reach a minimum amount of cups, and then the partitioning behaviour will cause our behaviour repertoire to change – our one remaining cup is broken! In such a manner we do arrive at the notion of an individual as a rather sophisticated pattern of behaviour.

past and the future. These operators play a large part in constructing the necessary descriptions. For example:¹⁵

A ((x while y) *whilenot* (z orwhile w)) A((x,y);(z:w))

In which the composite expressions also refer to behavioural invariants having existences that are functionally dependent on their components.

The correlate of material implication in propositional logic is the norm, for example:

A (y whenever x) A(y-x)
A (x then y) A(x-y)

the existence of which is not functionally dependent upon the existence of its components x and y. A norm specifies a mechanism, physical or social. This is also an invariant.

Another way of representing a mechanism is to do so without saying anything about its structure by naming the ability to behave in a certain way. For example:

A walk *able* Aw*

In a similar way, we can name two other related behaviours, the beginning and the ending of an invariant:

A walk *begin* Aw<
A walk *end* Aw>

which are *our* names, not necessarily A's names for those behaviours. The agent A may not be aware that x and x< are related. In order for the agent to behave intentionally, he will have to recognise the connection.

So far, although we have introduced the notion of existence into the discussion, nothing has been said about time. Time is a rather sophisticated construct that depends upon the agent having, first, the ability to use one form of behaviour to represent another. The model of behaviour introduced so far is sufficient to account for the appearance of semiological behaviour. (But that is another long story.) All we need to recognise is that the agent has the capacity to behave in a way that signifies something else:

A''Bx''

represents A realising a sign, ''Bx,'' meaning Bx. The precise nature of ''Bx'' is often of indifference to us in modelling behaviour, the use of voice, print, picture, electronic signals, and so would all be covered by the same expression provided that the agent A were using any of them to mean ''Bx.'' One important result of this analysis is that we can easily go on to show the communication acts that the agent can perform with the sign

A ''Bx'' asserts A ''Bx'' commands A ''Bx'' suggests

for example. The interpretation or misinterpretation of a physical signal is not considered here but this more detailed level of analysis is readily accommodated.

Once the agent has acquired the ability to use signs he/she can do more than live only in the here-and-now (see Mead 1932). The well-formed formula, Ax, represents A being in the invariant state x. The syntax only allows one to represent the here-and-now. The start and finish of the invariant cannot be known directly, one is always in the past and the other in the future but the agent can here and now use signs to represent them. We use these symbols:

A walk *start* A walk *finish*
Aw+ Aw-

¹⁵ The abbreviations that we use for the logical operators (e.g., ;: for *while*, *orwhile*, and *whilenot*) are introduced without other explanation than the presentation of the formula in the two versions.

Thus we are able, in our current behaviour, to accommodate worlds that are past, future and distant. The importance of signs in social and legal behaviour cannot be overestimated. We should distinguish, of course, between the internalised norms and the signs representing norms, "rules" are what we usually call them.

The fundamental notion of responsibility has also to be given an explicit place in the formalism. Every realisation has an associated authority for its existence, symbolised thus

$$Ax@$$

This may be an agent, often it is a sub-agent of a group agent. It may also be a norm expressing the combined judgments of several agents. Ultimately, the authority always reduces to a set of human judgments. In other words, this logic will always point to agents in the social system who are responsible for the use of the constructs expressed in the formalism.

Every realisation has an associated authority. So every compound pattern of behaviour has its authority, so the logical combinations that in classical logic we are free to assemble at will, and even assemble mechanically, need to be authorised in Norma, strictly speaking. From a mathematical point of view this is a dreadful restriction but for modelling the social world, the restriction is realistic. In particular, although we have accepted such facts and norms as

$$\begin{array}{l} Ax \\ A(y \text{ whenever } x) \end{array}$$

$$\begin{array}{l} Ax \\ A(y \rightarrow x) \end{array}$$

we do not take it for granted in Norma that we are allowed to make combinations of norms and facts, such as

$$A(x \text{ while } (y \text{ whenever } x))$$

$$A(x, (y \rightarrow x))$$

Such an act is not automatically permitted by the logic of the system, as in practice we assume that a competent judge will take responsibility for invoking the norm. It would be unwise to make the authority, as in classical logic, some universal rule permitting the unrestricted combination of expressions recorded in the formal system. Of course, we may wish to make use of this kind of mechanical linking of formulas but we should not make the mistake of assuming that the laws of logic are divinely authorised for all places and all times. They are human constructs with human authority behind them. All too often, the dogmatic logician (like the fundamentalist believer) insists upon pushing logical rules beyond their limits of practical validity.

This language is very strange from a mathematical point of view. It can never be fully represented as a closed formal system. The agent responsible for the formal expressions is needed to complete the well-formed formula. (The author of the expert system is one factor in its expression.) In Norma, one has no alternative but to represent an open system. One is always referred, by the authority, to the containing social system. In Norma one cannot deal with a finite system because every behaviour it represents has other behaviours necessarily associated with it – the ability, the beginning, the ending, the sign for it, its authority – and these, recursively, have theirs. No matter how deep his analysis, the knowledge-engineer (dreadful, misleading expression!) has ultimately to pin his faith upon the informal system. Norma shows where to put the pins.

13. Semantic Problems Solved?

The kind of logical language outlined above is potentially capable of capturing the complexities of real social behaviour. As pointed out, if you want to simplify, you can do so. But, if you decide to simplify, you have no alternative but to take responsibility

for imposing your simplification. At least we may, in the new framework, choose to describe our legal system as a mechanical bureaucratic structure but the new kind of logic proposed will not force us to do so.

The mechanical nature of the classical logic approach, as observed above, introduces semantic problems. They were classified as either theoretical or as by-products of applications to expert systems. Let us look again at those points and see how far the proposed new framework might solve them.

The theoretical problems identified relate to the concepts of truth, individuality, identity, extension, and the retreat into syntax. Truth is to be abandoned as a primitive concept. Truth, in the context of social behaviour is a very sophisticated notion that depends upon some responsible agents reaching a consensus on the matter in hand. Existence here and now takes the place of truth as a primitive concept, with the benefit of being a concept that can readily be operationalised. Individuality and the identification of individuals are also regarded as sophisticated concepts that an agent discovers only after a few years of experience which includes playing such games as peek-a-boo! In the legal domain it would be foolish to assume that all questions of individuality and identity are intrinsically resolved in some objective reality, whilst all we have to do is to uncover these facts. Heraclitus's river is the same river if all he does is to walk along its banks with his dog or gaze at it from the same bridge, but if, employed by the local water authority, he has the job of tracing its contents on their way to the sea, his different behaviour repertoire in this different context gives the word "river" a different meaning. If the concept of an individual is lost, so is the concept of a set of individuals defined extensively by enumerating its members. The idea of a behavioural invariant is close to the idea of an intension. Finally, we spurn the evasion of semantic issues by retreating into syntactics. All these theoretical advantages are justified by their contribution to giving us an *operational semantics*.

The application problems that commonly arise when predicate logic is used for building expert systems were seen to be numerous. They are almost entirely caused by the freedom to formulate fat predicates. This liberty leads the analyst to invest a private language, introducing complexity, system rigidity, artificially enforced uniformity, the illusion that the machine uses natural language, and explains many of the difficulties in maintaining and merging systems. The new framework requires us to analyse legal norms down to the level of individual words or equivalent semantic elements and to place these in an ontological structure that goes a long way towards removing the arbitrariness of the analysis. This analysis gives us flexibility, a genuine uniformity to which diversity can be added by linking different interpretations to different agents, and insight into the operational meanings of our natural vocabulary. These benefits arise from an insistence on having an operational semantics and ruling out-of-order mathematical shortcuts, however elegant they may appear.

14. Jurisprudence in Support of the New Framework

As a coda, we may ask whether the quest for a radically different kind of logic is justified by the arguments of legal philosophers who cast doubt on the notion that the law is a system of rules. This task is made easier by Susskind's excellent book (Susskind 1987). He has marshalled their principal arguments preparatory to dismissing each of them in turn. Susskind rejects them on the grounds that, despite their force, they still leave open the possibility of useful practical applications for mechanical devices that can simulate deductive reasoning within a system of explicit rules. I agree with his thesis but prefer to classify this residual set of applications as

"bureaucratic expert systems." However, the arguments he dismissed provide strong support for pursuing the very different line of thinking advanced here which can lead to systems supporting the decision-maker or adviser faced with the semantic problems that the bureaucratic expert system leaves untouched.

The courts seldom concern themselves with disputes about the accuracy of a chain of deductive argument, but rather adjudicate on disputes about meaning or the assignment of liability either at the substantive level or at the level of procedure. Legal problems that go before the courts may certainly entail a measure of deductive reasoning but much of the required reasoning can only be carried out by the exercise of creative thinking combined with judgment and accountability. This kind of reasoning cannot be mechanised. However, we can support the person engaged in reasoning about meaning or responsibility if we use a logic that deals with the semantic elements of natural language and which does so by clarifying who has the authority to convert words into actions either directly (the hangman) or at several removes (the clerk of the court). I propose that we explore the line of thinking described here as a new framework in order to build systems to support the lawyer in his quintessential legal work.

The names of the arguments cited below are those coined by Susskind and the quotations are of his words or from the authors he has quoted. Just two of his arguments are considered but the others would also support the position advanced here.

Argument from Act of Will (Susskind 1987, 174). "Hart captures the thrust of the argument in the comment that 'rules cannot provide for their own application, and even in the clearest case a human being must apply them'." Susskind also quotes Hart saying "fact situations do not await the judge neatly labelled with the rule applicable to them" and "rules cannot claim their own instances."

No self-contained logical system can supply the will that Hart refers to or the "judgment" that Kant, an earlier proponent of this view, points out that logic does not provide. However, the proposed logic of action, Norma, is being devised to account for open systems. It cannot be treated as a closed system and its syntax is designed to force the analyst to draw attention to the agents who must supply the "will" and the "judgment." In fact, because it presupposes a responsible authority for every realisation, Norma provides for a link reaching from the formal structure held by the computer to the informal, human system, for each of the cases cited by Hart requiring an agent responsible for:

1. existence of the norm –
the agent who successfully began the norm's existence
2. expressing the facts in terms employed in the norm –
the author of the sentences expressing the facts
3. invoking the norm –
the agent responsible for conjoining the facts and the norm
4. communicating the result with due authority –
the one who is empowered to perform the communication act

A given body of legal norms (some tax law, for example) may not deal with these issues directly, relying on other statutes. The Norma syntax provides a place for this information, and it is up to the analyst to use when appropriate.

The third case has been touched upon already. It was earlier noted what a grave assumption is made in the belief that the laws of logic apply categorically in any formalised legal knowledge-base. Should this assumption be made, then someone must explicitly take responsibility for it. For example, if you want to use the rule of *modus ponens* then you may, but you will have to incorporate that rule quite explicitly

into the system *and acknowledge your responsibility for doing so, together with your indirect responsibility for the results it generates*. Judges do not indiscriminately link facts and rules to draw "the logical conclusions" because the results can be unjust. Logic is a mechanical model of language; there is no licence to drive it everywhere except perhaps in the Platonic world of mathematics.¹⁶

It is interesting to note that Susskind's expert system for the Scottish law of divorce does have an informal treatment of the notion of authority. This provides a partial answer to the question of who supplies the will to make the norm system function. I am proposing that a formal treatment of authority should be a necessary component of any logic to model social or legal affairs.

Argument from principles (Susskind 1987, 169). "Dworkin argues that lawyers and judges, while solving legal problems, as well as reasoning with rules, often also have recourse to non-rule standards that he terms 'principles'." These principles do not lead to necessary conclusions but lend weight or probability to certain possible conclusions. Often they are formulated at a far higher level of generality, with unlimited exceptions hence incapable of being reduced to rules. "There is no such thing as 'the law' as a collection of discrete propositions." Hart goes so far as to say that "it remains the judge's duty, even in *hard* cases, to discover what the rights of the parties are, not to invent new rights retrospectively." Principles are essential to this task.

This argument points to an essential openness in legal reasoning. A mechanical, deductive system will sooner or later break down. Comparing it with a machine in a factory, the operative may have done all he can to make it work, but a point comes when he must hand over to the engineer or manager to take actions that have never been prescribed in the handbooks. Engineering and managerial expertise, like the lawyers' expertise, goes beyond the books to the principles they have learned. A solution to the problem has to be found; they cannot opt out.

If one accepts Dworkin's views, one might attempt to accommodate these principles as additional rules together with a host of illustrative exceptions. To do so would be to fall into the Artificial Intelligence trap: The ridiculous attempt to usurp the roles of people.¹⁷ Applying classical logic to expert systems perhaps encourages the tendency to fall into the Artificial Intelligence (AI) trap by compelling one to work in a closed system. The same computing techniques (the genuine, non-ideological contribution of AI) can be employed to offer social groups a medium in which they can collaborate more effectively. That is the spirit in which the new framework is proposed. It permits any desired degree of automation but it links every relevant decision point to the human agent involved and so acknowledges the social context of legal and other practical affairs. However, it will not permit closed models to be formulated, but always it involves the informal system which sustains the principles to which Dworkin has rightly drawn our attention.

¹⁶ Even in mathematics, there is not a universal agreement about the logical rules which can be applied legitimately (Bloor 1976; Haak 1978; see the discussion of Brouwer in Kneale and Kneale 1978, and Lakatos 1979).

¹⁷ Very few AI practitioners among themselves fall into this trap but they are not always scrupulous about warning the less sophisticated where to tread. Some are even prepared, in their advertising copy, to express themselves in a manner that might mislead the layman into a belief that the expert systems they are selling can, in effect, place the relevant expert on the user's desk. Susskind himself (1989), sadly, falls into this excess in the opening paragraph of an article on his Latent Damage expert system: "Imagine the Chairman of the Law Faculty of Oxford University sitting on the desk of every lawyer in the land and always ready for consultation."

As Dworkin indicates, the judges uncover the relevant law that exists within the informal legal system. He argues that we cannot make a complete, explicit representation of a system of general, probabilistic standards that have unlimited exceptions. There is no need to pretend that we can. A logic which enshrines openness in its syntax denies the pretence. The openness of the legal system means that, no matter how much of the law and the given situation you have reduced to explicit formulas and rules, much more remains unsaid. But a responsible agent can invoke the unspoken principles within the informal world of law-in-action, and stop a deductive chain that would otherwise lead to a miscarriage of justice.

Argument from Particularity of Facts. Susskind (1987, 181) quotes Hart again: "Fact 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. Instead, in applying legal rules, someone must take the responsibility of deciding what words do or do not cover some case in hand, with all the practical consequences involved in this decision." We have already dealt with the responsibility issue but the new issue raised by this quotation concerns the problem of choosing descriptive terms in which to report the facts of a particular case.

"The facts of any case can always be characterised in a vast number of different, highly specific ways . . ." but the vocabulary we employ will be related to the norms invoked. Susskind appears to favour a scheme in which the user and the law relating to his case are kept so far apart that they do not interact until the deductive process begins. "It is possible, in principle, to have a system with such extensive knowledge that any judgments made in relation to questions actually answered by the user would be so far removed from judgments of law that it would be obtuse to withhold the term 'deductive' in relation to the process of legal reasoning executed by the computer" (Susskind 1987, 181).

The proposed new paradigm incorporates the principle that meanings are relationships between linguistic structures and behaviour, hence we are led to adopt the position that the reporting of the facts will justifiably always be coloured by the norms. It is obvious that the terms used to characterise a case must take some of their meaning from the norms that are considered relevant, simply because the behaviour induced by using the chosen descriptors will be mediated by the norms. Children are fond of playing this kind of semantic trick: "What's in my hand? Get it right and I'll give you a penny." The prankster is safe, the answer "Nothing" will bring the riposte "Wrong! I've got air in my hand" but the answer "Air" leads to "No. My hand is in the air but nothing is in my hand." The same kind of semantic manipulation forms the basis of many a confidence trick and dubious sales technique. Unless you know the behaviour that will result from the various formulations from which one might reasonably select a description of a case, one does not know the meanings of the words to be employed in that society in that legal context.

For a computer system to help with this kind of semantic problem-solving it must reveal the links between the choice of words and their legal consequences. By attempting to lock legal knowledge inside a black box we do the opposite. Knowledge, justice and other important social constructs have to be understood and constantly rehearsed in a society even to exist. Expertise obscured from critical appraisal inside computer packages should not be considered acceptable.

Appendix

A Simple Example of the Semantic Analysis and Norm Analysis Techniques of MEASUR: Canadian Unemployment Insurance Law – Revised Statutes of Canada (1985), Ch U-1

To illustrate the method of Semantic Analysis outlined in this paper, here is an example taken from Mackaay et al. (1990).

Work on the formalisation of legal systems to handle the law has tended to neglect the problems of methodology that become serious issues when one scales up "desk" research to the size of real systems. The LEGOL/NORMA research programme has generated a methodology suitable for such problem areas. It is called MEASUR. It incorporates a variety of analytical techniques that take one from the articulation of somewhat vaguely stated needs (for example, at the earliest stages of legal drafting), through the analysis of meanings, to the formulation of norms. The second and third phases are illustrated below. Two further stages deal with the elaboration of relevant procedures and appropriate sanctions. Of all the techniques included in MEASUR, that of Semantic Analysis has proved to be the most important.

Phase I – Semantic Analysis

Step 1: Generate list of candidate semantic units

The problem domain has to be reduced to semantically atomic units each of which corresponds to an invariant in the behaviour of some responsible agent. The analyst begins by listing candidate semantic units for the problem or application domain. Here we select the significant items from the small sample of the act covered by this example. Great care is not important at this stage. We could select all the words in the text not accounted for by functions within the system. Thus:

Sec. 18.(1) [. . .] the qualifying period of an insured person is the shorter of

(a) *the period of fifty-two weeks that immediately precedes the commencement of a benefit period under subsection (1) of section 20, and*

(b) *the period that begins on the commencement date of an immediately preceding benefit period and ends with the end of the week preceding the commencement of a benefit period under subsection (1) of section 20.*

Sec. 20.(1) A benefit period begins on the Sunday of the week in which

(a) *the interruption of earnings occurs, or*

(b) *the initial claim for benefit is made*

whichever is the later.

Step 2: Classify the candidates

This is not a significant task for this example but it helps to look for the following classes, among others.

1. responsible agents, e.g., *person*
2. roles indicative of agents (e.g., claimant)
3. relationships indicative of missing components, e.g., *insured* which requires two agents *person* and *state* so we add *state* to our candidate list
4. periods used in formulating conditions, e.g., *qualifying period, week, date*
5. particular values of measuring or classification frames, called "determinants," e.g., *Sunday* which may be indicative of missing determiners
6. measurements or classification frames, called "determiners," e.g., *day* (or *day of week*).

Our attention is now drawn to *week* as a unit of measurement of a duration (a determiner applicable to every invariant) *52 weeks* may be a determinant for a duration of a period. Other questions are suggested. Is *week*, in the sense of a period named by the current state of a calendar/chronometer, different in meaning from *week* in the expression "*52 weeks*"? We need to check the interpretation of *week* – does it have

a standard meaning as an interval lasting 7 days of duration starting on a Sunday or does it have a different meaning in the context of the act? [We shall treat 52 weeks as a determinant.]

7. semiological behaviour – e.g., *claim* which is a “speech act” performed by a person using a sign, the meaning of which is the benefit he or she wants.

Step 3: Create an ontology chart

Time is central to our understanding of meaning in the context of this method. Every word or expression that is a semantic unit corresponds to an invariant in the flux of events or behaviour of the agents. Thus, to know the meaning of a word entails knowing when the corresponding invariant starts and finishes. The existence of each invariant depends upon the existence of others, hence we can clarify meanings by constructing an ontology chart to demonstrate these dependencies. See Fig. 1.

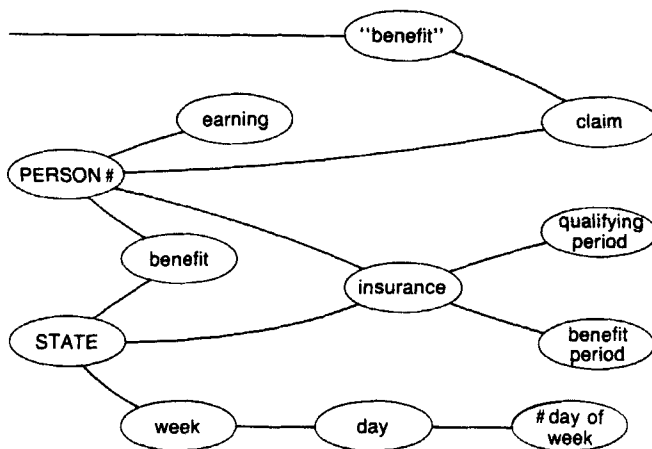


Figure 1: A specific ontology chart for a fragment of legislation

Notes:

1. The responsible agents are given in capital letters.
2. Each element names a universal for which there will be numerous particulars.
3. Determiners are prefixed by #, their determinants are omitted here just as names of individuals are omitted.
4. Signs, such as “benefit” have the relevant linguistic community as their antecedent.
5. The invariants in behaviour are often dependent on others (see the discussion in the first few paragraphs dealing with the “New Framework” in the main body of the paper, above). Thus *benefit* can only exist as a joint invariant of PERSON and STATE. It may appear that the *insurance* contract between PERSON and STATE should be an antecedent of *benefit* but the entitlement/obligation referred to as the benefit, though created by the legislation, will not necessarily cease to exist if the legislation is repealed, it may be paid subsequently and cease to exist then.
6. Notice that PERSON, STATE and the sign “benefit” have no stated antecedents. As the root agent we may assume the community at large, as the custodian of commonsense meanings.

We may supplement this with other ontology charts to clarify meanings of certain elements. Some such fragments of analysis are very general and belong in a library of semantics. For example

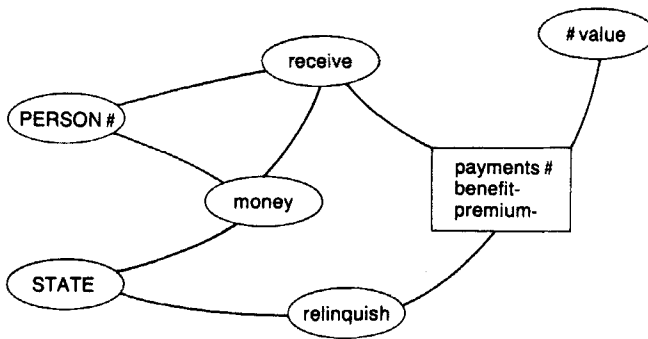


Figure 2: A generic ontology chart for "benefit-payment" and "premium-payment"

Notes:

1. The antecedent for *money* is most probably the STATE but it could be the responsibility of another agent (e.g., ECUS in the EEC).
2. The box under *payment* lists specific forms including *benefit*.
3. Notice that *payment* is a process taking place during the co-existence of *receiving* and *relinquishing* acts.
4. Ownership enters here – the processes of beginning ownership = receiving
ending ownership = relinquishing.
5. Beginning and ending processes are quite different ontologically from start to finish times which are signs indicating when, respectively, a beginning and an ending were successfully completed.

Phase II – Norm Analysis

Having made it clear what we are talking about by constructing an ontology chart showing the relevant words organised as a structure of behavioural invariants, we can begin to specify the authorities governing behaviour in our problem domain. In the case of an informal system, we should probably only indicate the agents responsible for deciding when instances of each type of invariant start and finish their existence. In the case of a formal or legal system, many of the authorities will be norms or agents empowered (conditionally) to take these decisions.

In this example we have two legal norms. One defines the start of a benefit period and the other, consisting of two logical norms, defines the start and finish of a benefit period. In LEGOL, they would be expressed as follows:

Context insurance (STATE,PERSON)

Start of benefit period [20.(1)] <- day of (# Sunday(day)
while (week while last of (finish of earning or while start of claim))

Note that the *context* operator specifies that the norm is applied to each individual case of its operand. This defines the antecedents of *benefit period*, *week*, *earning*, and *claim*. This simplifies the expression of the norm. Also note that all the logical operators take account of time. The system has always been implemented with

one-sided open time intervals, the start being part of the period but not the finish. One needs to check the formal interpretation.

The benefit period is tagged with the reference to the norm defining it. Of course, start and finish may have different authorities. The other two norms can be specified within the additional context of a single benefit period.

Context add benefit period

Finish of qualifying period [18.(1)] <- *start of benefit period*

Start of qualifying period [18.(1)] <- *last of ((finish of qualifying period minus 52 weeks)*

or while start of prior benefit period)

The efficiency of evaluation would be improved by defining a function *the previous* to select only last of the *prior* instances of an invariant type.

Norms themselves have periods of existence and so do the universals in the ontological structure (the analogue a database schema). Thus changes of meaning can be handled easily. The ontological structure, however, tends to be very stable, only changing with major paradigm shifts. Hence this method has advantages in the design of large administrative systems where restructuring massive files is often too great a task to contemplate. Once an unsuitable database structure has been implemented one is struck with it and with the resulting inflexibility of the system. Using the method of semantic analysis, one obtains a structure that can easily be extended in scope or detail, leaving the associated norms unaffected. The amount of thought that must go into the preparation of the semantic scheme before the system is built is the extra "up-front" investment, but this thought can help to uncover some suspected legal problems before drafting errors are made, and so bring immediate dividends.

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