COMPUTER REPRESENTATION OF THE LAW

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ABSTRACT

For the purposes of this discussion there are three main types of law: definitional, normative and case law; and there are a variety of computer representations of knowledge and problem-solving which can be applied to law. The social implications of representing the law by means of computer depend upon both the type of law and the technical means of computer implementation.

Definitional Law. Much of human law is already written down in the form of fairly precise rules, regulations and definitions. There is a separate legal tradition, represented by the work of Layman Allen in particular, which has long advocated the use of simplified forms of logic to represent law.

Recent work at Imperial College has confirmed many of Allen's expectations. We have succeeded in representing a significant portion of several British laws in Horn clause form and various of its extensions. Among other applications, we have been able to run a significant portion of the 1981 British Nationality Act, implemented in PROLOG on a small micro computer. The first subsection of the Act, for example, can be expressed in the conclusion-conditions form of a single Horn clause:

For every individual x, date y, individual z
and section of the Act w,

x acquires British citizenship
by section 1.1.a on date y
  if x is born in UK on date y
  and y is after the Act takes effect
  and x has a parent z
  and z is a British citizen
    by section w on date y.

Not all of the Act can be easily represented in such a simple form. We have expressions such as:

"x is a citizen if ....
    and his mother is a citizen
    or would have been a citizen
      had she been male."

This requires a representation of metalevel reasoning about states of knowledge in addition to object level reasoning about the world. Investigation of such problems of representing legislation and legal reasoning has had a salutory effect on our more general study of knowledge representation and problem-solving.

Other applications of computational logic to the representation of definitional law at Imperial College include immigration law, social security law, grants to industry and a company's pension regulations.

Our studies suggest that such applications of computational logic are ripe for practical exploitation. Computational Logic can be used not only to assist the application of rules and regulations, but also to aid the process of determining the logical consequences of legislation before it is enacted. It can be used not only for rules which have legal authority but also for rules which are used by organizations to regulate their own internal affairs. Potential applications Include the formalization and mechanization of tax law, company law, airline regulations and university examination regulations.

The technical opportunities are significant and may result in the development of systems which have great social impact. How can we be sure that the computer representation of laws is accurate; and therefore that the conclusions they imply are correct?

On the other hand, our experience suggests that precise formal representation of the rules actually clarifies and often simplifies them. This same point was made by Layman Allen as long ago as 1957. In the long term we may be so attracted by the benefits of formalization that the real question becomes: How can we be sure that the natural language statement of the law does justice to its legally binding formalization?

Normative Law. Many laws are concerned with permission, prohibition and obligation. Traditionally this is an area where modal deontic logic has been thought to be necessary. Typical examples are parking regulations, criminal law and the ten commandments.

We have only begun to scratch the surface in our investigation of such laws. However, our dissatisfaction with modal logics has forced us to consider how norms might be handled within the framework of classical computational logic.

It can be argued that to say that an action is prohibited is to say that some punishment or other sanction can be expected if the action is performed. Thus something like

Prohibited(a)
in a modal logic

becomes

there exists p such that
Expected-result(a p) and
Undesirable(p)
in a classical logic.

Whereas classical logic requires us to refer to sanctions explicitly, modal logic wraps them up within modal connectives. Classical logic allows and even encourages us to identify sanctions explicitly, e.g.:

"Parking in a no parking zone
oarries a fine of 25."

But it also allows us to existentially quantify sanctions if we don't know or want to say what they are, e.g.:

"Cheating on examinations is prohibited"

means there exists a punishment for cheating on exams.

We believe that such a treatment of deontic concepts is technically attractive. It increases expressive power and allows existing proof procedures for classical logic to be used for deriving logical consequences from assumptions. These arguments are the same as ones we have made elsewhere for treating notions of time and events explicitly within classical logic rather than implicitly within modal temporal logic

Such a teohnical solution to the problems of representing and reasoning with norms may further our ability to implement practical systems. But encouraging explicit reference to sanctions may have undesirable social implications, whether or not computer implementation is involved. It may encourage us to weight up the relative costs and benefits of breaking the law. A parking fine is virtually no punishment for a wealthy businessman. A person who is terminally ill or about to commit suicide has no punishment to fear, unless he believes in an after life.

case <u>Law</u>. A significant proportion of law in English speaking countries is based upon previous cases which create a preoedent for the future. Even where precedents have no legal authority, previous oases must be considered for the sake of consistency and fairness. The need to reason by oases is also built into the lower levels of much definitional and normative law: What does it mean, for example,

"to exeroise reasonable effort",
"not to have residence in the U.K.
as one's primary intention of marriage"?

Suoh notions can only be determined by developing relevant criteria and applying them flexibly over a period of time.

Attempts to formalize case law in Artificial Intelligence have been attracted to its similarity with reasoning by analogy and with reasoning by means of frames.

However there is an alternative - which is to generate general rules by Induction from previous cases and apply them to new cases in the future. Rules so generated do not, of course, have the same legal authority as rules which are explicitly written down. They may be too general or too narrow. They may conflict with other rules generated from other cases. Belief revision is needed to discriminate between conflicting rules arising from different precedents.

A certain amount of support for such a treatment of precedent can be obtained by referring to the arguments which are given when a decision is made in a particular case. If the case is to be a preoedent for the future then the justification for the decision is usually made in general terms. In other words, the justification itself contains the main ingredients of a general rule.

We would argue that treating case law by generating tentative general laws is not only technically preferable to reasoning by analogy and by frames but it is also socially more desirable. It has the consequence that general rules can be cited to justify individual decisions. Since we know what the rules are, they can be scrutinized and changed. Transformations which reason by analogy or frames are inscrutable and therefore beyond social criticism.

<u>Legal Expert Systems</u>. The state of technology is rapidly reaching a stage where the computer representation and processing of law will make legal expertise available to a much broader spectrum of the community.

In general this is to be welcomed. It will give more people better legal and financial advice. It will help more people to understand the law, so that they can make better, more informed decisions.

But there are dangers too. There are the obvious dangers: Who is responsible if the computer makes a mistake? Less obvious perhaps, and more insidious therefore: Will we bother to listen to the computer's explanation? Will we bother to understand the issues involved? Or will be come to rely on the machine to do our thinking for us?