Investigations into the Application of Deontic Logic

Nienke den Haan

Abstract. This paper discusses the results of a study for representation of law. Starting point is a legal knowledge based system for the Dutch traffic law that treats permissions as specialized obligations. The results of this prototype system have been evaluated and were the subject for further study. The second half of this paper looks into computationally attractive formalisms that capture deontic modalities more naturally.

1 Introduction

Deontic logic is used to reason about ideal and actual worlds. Its most important applications within the area of computer science are legal applications. There are however more interests (cf. [Wieringa & Meyer, 1991], [Kwast, 1991]), such as authorization mechanisms for databases, or system specifications for descriptions of permitted and forbidden states. In every case where behaviour is to be prescribed, deontic logic finds its application. In this paper the application of deontic logic in legal knowledge based systems will be discussed. Jones and Sergot describe in [Jones & Sergot, 1992] the problems one can encounter employing the application of deontic logic. They agree that applications of deontic logic provide extensive grounds for (future) research. This research is aimed at legal reasoning about law texts, since the European continental law system is statute based, as opposed to the Anglo-Saxon systems which are highly case-based. The goal of law texts is to provide a framework for general accepted or agreed upon norms.

To adequately design legal knowledge based systems (LKBS) constraints on flexibility and isomorphy must be met (see also [Bench-Capon, 1989]). Since law texts are frequently updated, such systems have to be flexible. Updates in the law texts, reinterpretations of terms and adaptations of legal reasoning should be supported. Some LKBS are based on decision tree methods, so additions or alterations of legal rules al-
ways require the decision tree to be changed. On the other hand, the representation of a law must be isomorphic to its original statement.

This makes the knowledge representation and the reasoning processes more understandable for (expert) users, and hence provides better explanation facilities. Some LKBS cannot model all necessary legal structures, such as exceptions. They have to be precompiled or require specific modelling by knowledge engineers.

Furthermore, additional knowledge is needed for the application of law: extra domain descriptions have to be provided in order to capture common sense knowledge LKBS would otherwise lack (see for instance the representations for various modalities in [McCarty, 1989] and his description of a language for legal discourse (LLD). In [Breuker & den Haan, 1991] a formalism was proposed based on the separate representation of world and regulation knowledge. The representations of legal rules (sections of the law) are better readable since the support knowledge necessary for interpretation is stored in the separate world knowledge base. The regulation knowledge is a direct translation of a law text, and all non-law specific terms are described in the world knowledge. The proposed knowledge representation formalism contains no special deontic operators for the representation of norms. In this article a system is presented that is designed according to this approach.

The method is tractable, performs legal reasoning in a similar way as legal experts, and the representation has a one-to-one correspondence to the original text of the regulations. In the approach described here exceptions do not have to be recognized and precompiled, because they are determined dynamically. This is a great advantage, since not all exception structures are explicit. During the application of law, implicit exceptions may occur when unexpectedly rules contradict.

The following paragraphs outline preliminary representation and reasoning formalisms which have been applied in a LKBS called TRACS (see paragraph 5). New representation attempts and viewpoints about deontic logic are reported in paragraphs 6 and 7.

2 A provisional representation formalism for rules

For the representation of obligations, prohibitions and permissions, deontic logic provides the $O$, $F$ and $P$ modalities. Since reasoning with deontic modalities is complex, in this approach we have proposed a scheme that excludes deontic modalities. The prescriptive nature of the law text is modeled using a dual world approach, in which the regulation forms the juridically ideal world, and cases/situation descriptions are excerpts from the actual world. The essence of deontic logic, which is comparing ideal vs. actual, is still the core of legal reasoning performed (see also [den Haan & Breuker, 1991]). The deontic modality $P$ is always an exception to either $F$ or $O$, and is translated to $O$ with extra conditions. An example is given in table 10.1.

The condition of a rule contains general provisions that constitute its application grounds. The conclusion describes the intended behaviour. In this scheme the representation of permissions is geared to the application of rules explained in the next paragraph.