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Ontologies: the Missing Link Between Legal Theory and AI & Law

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Abstract

It has been claimed that there is or should be a connection between Legal Theory and Artificial Intelligence and Law (AI & Law). However, the nature of this connection has been left largely unidentified. In this article we propose that this 'missing link' can be provided by the specification of *ontologies*. This article discusses the role of ontologies in AI & Law and Legal Theory, and the benefits that an attention to ontological issues can provide. It is shown that ontological assumptions can be found in the works of major legal theorists, as well as in many approaches to AI & Law.

1 Introduction

It has been recognized by several authors (e.g. [Gardner, 1987], [Susskind, 1987]) that Legal Theory is important to AI & Law and vice-versa. The influence of Legal Theory on AI & Law can be found in two basic flavors. First, AI & Law formalisms can be constructed based on jurisprudential theories, as for example it was done in [Allen & Saxon, 1991], [Hamfelt & Barklund, 1989] and [Valente & Breuker, 1994a]. Second, we find AI & Law research directed by questions raised in Legal Theory, which is used as a source of relevant research questions to be analyzed and perhaps solved with the help of AI technology. For instance, the issue of *open texture* [Hart, 1961] and the distinction between 'hard' and 'easy' cases are research issues in AI & Law which have been 'borrowed' from Legal Theory. On the other hand, the interest for AI & Law in Legal Theory has been more a curiosity than a commitment to collaboration. Despite some recent interest from legal theorists on AI & Law (see e.g. a recent special issue of *Ratio Juris*'s on the subject), there is, to the best of our knowledge, no comprehensive jurisprudential inquiry on the use of AI techniques in Legal Theory.

In spite the claims to the importance of Legal Theory to AI & Law, the interaction between the two fields has been small. Part of the reasons for this are of a practical nature. There seems to be considerable skepticism from legal theorists (and lawyers in general, for that matter) with respect to the role and potential of the use of AI in Law and Legal Theory. Moreover, judging by the large majority of works in AI & Law, which do not attempt in any way to use or feedback Legal Theory, skepticism about the connection is likely to be shared by AI researchers. Clearly, while it is known there is a

connection, its instrumentalization is a task yet to be performed. Where is the missing link?

AI has borrowed the term *ontology* from Philosophy to mean a description of what the world (or a certain domain) is made of. In this (AI) meaning, ontologies have been pointed as central elements in the design of knowledge representations [Davis *et al.*, 1993], particularly with respect to commonsense knowledge [Lenat & Guha, 1990]. Research on ontologies plays an important role in several AI application fields, for instance AI & Medicine [Schreiber *et al.*, 1993] and Qualitative Reasoning about Physical Systems [Weld & deKleer, 1990]. Throughout this article we will use the term *ontology* in the AI meaning and **not the philosophical one**.

This paper argues that ontologies can work as an instrument to connect AI & Law and Legal Theory. Our argument has three main steps. First, we will argue that the specification of ontologies can be beneficial for AI & Law in general. Second, we will argue that the best source for ontological commitments for AI & Law ontologies is Legal Theory, in particular the legal theories which identify in their theories a number of 'fundamental concepts' and the like (such as the ones by Kelsen, Hart, Bentham and Hohfeld). Third, we will argue that, with this connection, AI & Law can be used as a (presently missing) testbench for legal theories, resulting in both a more consequent Legal Theory and a more principled AI & Law. In this article we define and exemplify what is meant by an ontology in AI, explain its intended role in AI & Law, and show how its use can benefit both AI & Law and Legal Theory. However, it is not within the scope of this article to propose a specific ontology.[1]

An important disclaimer is as follows. Several of the issues we bring up in this paper may look like commitments to certain positions in philosophical and legal theoretical debates. They are not; we do not want to enter these debates. While the very discussion of ontologies and knowledge representation (and AI in general) implies to some extent certain philosophical assumptions (e.g. the existence and representability of knowledge), our point of view is an engineering one. We are only interested in building knowledge-based systems.

The remainder of this article is structured as follows. First, we discuss and exemplify the concept of ontology in AI in general, and detail how the specification of ontologies can be beneficial to AI & Law. Then, we argue that ontologies can be the connection between Legal Theory and AI & Law, by claiming that the ontological views and conceptualizations used in AI & Law should be drawn from Legal Theory. We discuss the main characteristics of these views and conceptualizations, and exemplify by presenting briefly a number of ontological views from major legal theorists. Finally, we discuss related work in AI & Law which has used some sort of ontological basis, whether from Legal Theory or not, and present our conclusions.

2 Ontologies in AI

It is impossible to represent the world in its full richness of detail. Thus, in order to represent a certain phenomena, it is necessary to restrict the attention to a small number of aspects which can be distinguished and which are meaningful (and enough) to a certain task or goal at hand. This 'restriction of attention' has been called in AI a

[1] However, we have proposed an ontology elsewhere [Valente & Breuker, 1994b].

ontological commitment. For instance, [Davis *et al.*, 1993] have argued that ontological commitments are an essential component of knowledge representation, because every knowledge representation assumes that certain things are in the world while others are not (or are not relevant). To some extent, the enterprise of representing knowledge and reasoning with it can be seen as the search for meaningful and adequate (either from an epistemological or pragmatic point of view) ontological commitments and their 'grounding' in representation formalisms which can be used to build knowledge-based systems.

A set of ontological commitments imply a *conceptualization*, i.e. a description of the objects, concepts and other entities which exist in a certain part of the world, as well as the relations between them. In order to discuss these commitments, AI has borrowed from Philosophy the term *ontology* to mean a specification of of a conceptualization (and thus a set of ontological commitments). In Philosophy, an ontology is a systematic account of Existence. What is called ontology in AI is perhaps closer to what has been called in philosophy an *ontological theory*: "a theory that contains and interrelates ontological categories, or generic concepts representing components or features in the world" [Bunge, 1977, pag. 11].

In AI, an ontology can describe a conceptualization of a *domain* (i.e. a part of the world) or a certain basic concept such as time or action (e.g. [Allen, 1984; Shoham, 1987]). Ontologies of domains can be more or less specialized, ranging from general descriptions of engineering mathematics [Gruber & Olsen, 1994] to elevators [Schreiber & Birmingham, 1994].

Ontologies comprise a number of *concepts* which describe classes of entities or relations in the domain. These concepts may be arranged in *typologies* which connect them in class/sub-class relations. The roots of these typologies are *primitive concepts*. The set of concepts in an ontology defines a *vocabulary*. In addition to this vocabulary, an ontology should provide the basic relations between the concepts. These two parts specify how the world is 'divided', i.e. which basic types of things are distinguished. For instance, an ontology of bibliographic entries in a bibliographic database[2] would contain primitive concepts such as *Document* and *Reference*, and subclasses of these such as *Book* and *Periodical* for documents and *Book-ref* and *article-ref* for references. Typical relations would be *Doc.Author* and *Ref.Keywords*. There are also *subsidiary* concepts to which descriptions of the primitive concepts refer. In the example, subsidiary concepts are *Author*, *Event* and *Date*. These concepts can be connections between ontologies, e.g. the ontology of bibliographic references using or incorporating an ontology of events or actions. However, this connection is not a necessary one. For instance, the concept of *Date* in a bibliographic reference is simple enough not to require a full ontology of time. Also, sometimes certain ontological connections may be not at all relevant. For instance, the concept of *author* may establish a connection to the domain of art (or artistic creation) which is probably not relevant for the point of view of bibliographic databases.

The primitive concepts of an ontology define a partition of the knowledge of the

[2]The examples that follow were taken from an ontology prepared by Thomas Gruber. despite not being published, the ontology is part of a "sharable ontology library which is publicly available in the World Wide Web (try *http://www-ksl.stanford.edu/knowledge-sharing/ontologies/README.html* as a starting point).

domain, which correspond to *knowledge types*. For instance, the primitive concepts used in the ontology of bibliographic entries shown above indicate there are two major types of knowledge, related to references and documents. In this sense, an ontology of a domain characterizes the knowledge about this domain under a certain perspective.

One of the main proposed uses for ontologies in AI is to enable knowledge sharing and reusability [Neches *et al.*, 1991; Patil *et al.*, 1992; Gruber, 1994]. A number of formal languages has been employed to specify ontologies, among them the Knowledge Interchange Format (KIF) [Genesereth & Fikes, 1992]. the advantage of such languages is that they tend to be simpler and more readable. However, the medium par excellence for writing ontologies seems to be logic, in which case the ontology is the statement of a logical theory (c.f. [Guarino & Poli, 1994]).

Below is the definition of the *Document* concept and the *Doc.Author* relation in Tom Gruber's bibliographic ontology. The language used is Ontolingua, a variant of KIF [Gruber, 1992]. With regard to the concept definition, note that document is a sub-class of *biblio-thing* (which denotes any entity in the bibliography domain); also, note that there are six comprehensive and mutually exclusive sub-classes of *document*: *book*, *proceedings*, etc. With regard to the relation, we can see that the relation is actually empty, in the sense that all that is defined is that it is a relation between an author and a document. This may happen frequently if there is only one (relevant) relation between two concepts, and the relation is to some extent self-defined.

```
(define-class DOCUMENT (?x)
  "A document is something created by author(s) that may be viewed,
listened to, etc., by some audience.  A document persists in material
form (e.g., a concert or dramatic performance is not a document).
Documents typically reside in libraries."

  :def (and (biblio-thing ?x)
            (has-one ?x doc.title))

  :axiom-def (subclass-partition
               DOCUMENT
               (setof book
                      proceedings
                      periodical-publication
                      thesis
                      technical-report
                      miscellaneous-publication)))

(define-relation DOC.AUTHOR (?doc ?author)
  "The creator(s) of a document.  Not necessarily the author of a
work published in the document, but often so.  The author is a real
agent, not a name of an agent."

  :def (and (document ?doc)
            (author ?author)))
```

3 Ontologies in AI & Law

By an *ontology of law* we mean in this article an ontology of the domain of law, i.e. of legal phenomena. As such, every ontology of law contains an account of what legal phenomena is, and a perspective to see it. However, because legal knowledge is closely associated to the formal sources of law (statutes, jurisprudence, etc.), ontologies of law may adopt (and frequently do so) as a phenomena not the legal phenomena in legal practice but these sources. An alternative perspective would be to describe law as the phenomena "what is decided in court", a thesis known in Legal Theory as *legal realism*. The ontological focus on legal sources seems to be a characteristic of *positivism*. Yet another alternative is to describe law as the *legal discourse*, i.e. the language used by legal practitioners. That seems to be the perspective used by McCarty in his *language of Legal Discourse* [McCarty, 1989] (see also a discussion of related work, below).

When a legal ontology is centered on legal sources, it may serve as a looking glass to interpret legal sources. That is, each legal source will be interpreted as containing one or more of the knowledge categories proposed by the ontology. For example, if one uses a Hartian ontology which proposes that legal sources are either primary or secondary rules, all legal sources will have to be classified as one or the other.

An additional aspect of ontologies which is important for law is that they constrain the *arguments* which can be used. Because it defines what types of legal knowledge there are and how they are connected, an ontology of a domain defines the *structure* of the arguments in this domain — to use Toulmin's terminology [Toulmin, 1969], what types of conclusions, valid warrants and typical chains are commonly used and/or valid. This may be an important factor if legal reasoning is viewed as the production and evaluation of legal arguments.

There is a number of benefits which the specification of ontologies can bring to AI & Law:

Putting AI & Law together The research in AI & Law is, at the moment, extremely fragmentary. Most of it is driven by local goals, such as to test the applicability of a certain technology (e.g. logic programming) to model a small aspect of legal reasoning (e.g. non-monotonicity) or legal knowledge (e.g. deontics) or to engineer an application (e.g. using isomorphism). Naturally, these are pieces of a puzzle, and intended as such. However, what seems to be lacking is some sort of picture of what the whole puzzle should look like. The specification of legal ontologies can be a way to 'make sense' of this largely unconnected research, and to provide a global understanding of where the field is going and where it is supposed to go.

Divide and Conquer In contrast with the bottom-up view described above, ontologies can also drive research in a top-down fashion. Once an ontology is specified, the problem of representing legal knowledge is naturally divided in parts which can be analyzed and solved separately and (to some extent) independently. Each category becomes a relatively self-contained basic problem which can be addressed and solved with more specific and therefore more effective approaches and techniques. Actually, this type of advantage is valid in general for all domains, and not only for law. For instance, if one adopts the ontological view that medical knowledge consists of symptoms, diseases and tests, the problem of representing medical

knowledge and medical reasoning is divided in the representation of each of these categories and an account of how medical reasoning uses them in specific tasks.

Principled Formalisms and Legal KBS As argued by [Davis *et al.*, 1993], knowledge representation formalisms express a set of ontological commitments. In AI & Law these commitments are frequently not given proper attention, sometimes leading to unprincipled formalisms and languages which are difficult to assess and compare. In addition, because representation formalisms are a primary aspect of the construction of knowledge-based systems, the use of a clear ontological basis is a very important factor in building principled legal knowledge-based systems. When such basis is available, the systems can serve as a pragmatic testbench for the views expressed in the ontology.

4 The Connection

We have shown in the previous section that the specification of ontologies can bring benefits to AI & Law. The open question is, where do these ontologies come from? Ontologies are not just 'given'. They are the common and distinctive conceptualizations of a domain of knowledge, which may be acquired by experiencing and thinking about the domain. That is why the typical ontologies are centered in the salient perspectives used to describe a domain. The connection with Legal Theory appears at this point: these features constitute one of the central aspects which are studied in Legal Theory. Of course one can create a conceptualization of legal phenomena 'from scratch' or based on personal experience of lawyers, but the perspectives and conceptualizations used in Legal Theory have the advantage of having been discussed and debugged in the course of years, for a research community whose work is centered on these problems. For the AI & Law community to create or use ontologies without regard to Legal Theory is a certain path to reinvent the wheel. In summary, the role we propose for Legal Theory in AI & Law is *to provide ontological assumptions and perspectives.*

In addition, the path can be used both ways. One of the problems of Legal Theory is that its products are rarely transformed into practice and tested. For instance, the Hartian ontological assumption that law consists of primary and secondary rules is brilliantly defended by him in his works and debated by many other theorists, but it has not been tested within law as an analytical tool to represent law and model legal reasoning. In this sense, a work like [Hamfelt & Barklund, 1990], which proposed and implemented a representation of legal knowledge based on this Hartian assumption is valuable not only for AI & Law but also for Legal Theory. In other words, the more AI & Law uses *explicitly* the ontological assumptions drawn from Legal Theory to build KBS, the more it will constitute a testbench for these assumptions and in the end for the legal theories themselves.

Even within Legal Theory in isolation, the specification of ontologies may be of benefit. One of the difficulties in Legal Theory is that some comprehensive theories are build under the background of some discussion, e.g. the distinction and separation of laws and morals. While these are important debates, they sometimes obscure essential aspects of the views proposed by the authors and which sometimes transcend the debate itself. When we represent (and preferably formalize) competing ontological views, it is possible

not only to express these views more clearly but also to verify more objectively what are the differences (if any) between positions in Legal Theory relatively independent from the problem they were built to solve. Ontologies may work, in this way, as a neutral and problem-independent medium where legal theoretical ideas may be expressed in such a way that they can be discussed and compared with more objectivity.

5 Ontological Assumptions in Legal Theory

There is in principle no restriction to the origins and perspectives adopted in the conceptualization of which the ontology is a specification. Whether these ontologies are common, social grounds for legal practice, and have emerged from this practice, or are the consequences of 'natural' (innate, rational) categories of justice is beyond the point. Essential is that no Legal Theory can do without the sources of legal knowledge and must have a view of what they invariably should contain in order to be legal sources, rather than guidelines, morals, or sources of power. Even if legal sources are viewed as defined by legal convention these conventions should contain the norms of what is to be considered legal and what not. Therefore, to some extent, a large part of Legal Theory has almost by definition an ontological flavor, and this flavor comes from a conceptualization of legal sources as the basic expression of law.

As we have pointed out above, legal theories usually contain elements of an ontology (ontological assumptions), but they are normally framed under some specific theoretical goal which lies beyond the ontology itself. For instance, Hart's theory intends to explain how legal systems evolve; Kelsen's goal was to demonstrate the difference between laws and morals; yet both propose very specific perspectives and conceptualizations of legal phenomena and legal sources in particular. Therefore, to 'extract' and compare the ontological views proposed by these authors is therefore not a trivial task, and one which we do not intend to pursue in depth here.[3] Nevertheless, in order to give the reader a flavor of what type of ontological views and assumptions can be found in Legal Theory, we present below a brief account of those views in the works of some major legal theorists and philosophers. We will emphasize the primitive concepts they have proposed to represent legal knowledge, which can be directly translated into an ontology. However, we do not intend to be complete, i.e. there are other concepts by these theorists as well as other theorists which are not mentioned by reasons of space.

Kelsen In his last work ('General Theory of Norms' [Kelsen, 1991]), Kelsen proposed four basic types of norms: command, empower, permit and derogate. *Commanding norms* command (prohibit, obligate) a certain behavior. *Empowering norms* give to some individuals the power to posit and apply norms under certain restrictions. *Permitting norms* refer to what he called the *positive sense* of permission. Kelsen argued that we may permit behavior in the sense that this behavior is neither prohibited nor commanded, case in which we have a *negative* (sometimes called *weak*) permission. In contrast, permitting norms use a *positive* sense of permission, in which behavior is actively allowed. Finally, *derogating norms* repeal of the validity of other norms. Derogation can occur in two different situations: when a *conflict* exists between norms, and

[3] For an interesting example of a well-prepared analysis of this type, the reader is referred to the first chapters of [Lindahl, 1977].

independently of such conflict. In the first case, a certain norm enters in conflict with another and is derogated, meaning that it 'loses' — the winning norm is to be applied, while the derogated one is not. In the second case, the norm-positing authority sees a norm to be undesirable and wants to repeal it, and does so by means of creating a derogating norm.

Hart The Hartian distinction between *primary* and *secondary rules* (norms) has become a quasi-standard in Legal Theory. Hart's distinction, carefully detailed in his 'Concept of Law' [Hart, 1961], draws a line between a first level which refers to human behavior and a second, meta-level of the first, which contains knowledge *about* primary norms. These secondary rules may belong to three types: (i) *rules of adjudication*, that can be used to determine authoritatively whether a certain primary rule has been violated or not; (ii) a *rule of recognition* which defines, directly or indirectly, which rules are the valid ones, and can therefore be applied; (iii) *rules of change*, which define how rules are to be made, removed or changed. These distinctions point out three functions of secondary norms: to provide support for solving conflicts (adjudication), to specify the limits of the legal system (recognition) and to specify how the legal system can evolve in time (change).

Bentham Bentham's theory is divided in two parts [Bentham, 1970]. The first is a *logic of imperation* which uses four basic operators: *commanded, prohibited, non-commanded* and *permitted*.[4] These are in fact interdefined, resulting in only one of the four as primitive. The second part is a *logic of obligations and rights* in which he defines three primitive concepts: *obligation, right to a service* and *liberty*. These are also interdefined based on *obligation*, which Bentham sees as an obligation someone has to the effect that something (some state of affairs) occurs. In summary, Bentham's theory is built upon two atomic concepts: *commanded* and *obligation*.

Hohfeld Hohfeld's theory is considered a landmark in American Legal Theory [Hohfeld, 1919]. An interesting (and unusual) aspect of Hohfeld's theory is that rights and other positional concepts that represent *legal relations* are considered primitives. There are two groups of interrelated legal relations, the first composed by *right, duty, no-right, privilege* and the second composed by *power, liability, disability, immunity*. The concepts in the first group are closely related to Bentham's concepts of right, obligation and liberty. The concepts in the second group refer to the *responsibility* of agents established in legal relations.

6 Related Work

As we have pointed out, ontologies and ontological assumptions have not been a specific focus of attention in AI & Law research. It is therefore difficult to trace the ontological assumptions which are inevitably part of AI & Law formalisms and systems. The most common ontological assumption in AI & Law research seems to be that law is to be

[4] A logic of imperation — an idea also mentioned by Austin [Austin, 1954] — was later developed in more detail by Hofstadter [Hofstadter & McKinsey, 1939], but it is presently considered to be superseded by deontic logics.

represented as (and to some extent *is*) either a set of rules or a set of cases, and is to be treated as such by reasoning mechanisms. Despite their dominance, it has been argued [Moles, 1992; Valente & Breuker, 1992] that these views are inadequate as a basis for the representation of law in computer programs. As we have proposed, this basis could be best substituted by a detailed ontology, preferably drawn from Legal Theory.

There are a number of works which have used ontological assumptions drawn from Legal Theory in the manner we suggest in this paper. The well-known work of Allen and Saxon (e.g. [Allen & Saxon, 1991]) attempts to represent law using the Hohfeldian ontological primitives (right, immunity, etc.). Hamfelt [Hamfelt & Barklund, 1990] proposed and implemented a representation of legal knowledge in which Hart's primary and secondary rules were mirrored in meta-levels of a logic programming formalism. There is also work which have an ontological flavor, but which has not been based on Legal Theory. For example, McCarty's Language of Legal Discourse [McCarty, 1989] can be seen as an ontology of Law, where his 'modalities' play the role of knowledge categories and are linked together with a formal (logical) presentation. The work on heterogeneous domains at the Vrije Universiteit in Amsterdam (e.g. [Walker, 1992]) has a flavor basically similar to our proposal: it recognizes the existence of different categories of knowledge in the legal domain, which are represented (and treated) differently. Research in *deontic logics* (as much as it could be seen as AI & Law) sometimes uses ontological assumptions from or is applied to legal theory — see for instance [Alchourrón & Bulygin, 1971; Alchourrón & Bulygin, 1981].

The only broad legal ontology proposed within AI & Law is, to the best of our knowledge, the one proposed by the authors. In [Valente & Breuker, 1994b], a *functional ontology of law* is outlined and discussed from the point of view of the construction of legal knowledge-based systems. The ontology has been elaborated using several ontological distinctions from Legal Theory, particularly from Kelsen, Hart and Bentham. It is outside the scope of this paper to discuss our ontology in detail (the reader is referred to the papers cited above).

7 Conclusions

In this article we have addressed the problem of the relation between Legal Theory and AI & Law. We have proposed that their common ground is the specification of *ontologies of law* which specify what categories of legal knowledge exist and how they are interrelated. We discussed the role and nature of such ontologies, and argued that an attention to ontological issues in general and the design of explicit ontologies in particular can be beneficial for both fields and provide for their integration.

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