THE FORMAL SPECIFICATION OF A LEGAL ONTOLOGY

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Abstract

In this article we address the formal specification of the legal ontology of Van Kralingen and Visser (published in October 1995). We discuss four issues encountered while formalising an informally described ontology, and present an ONTOLINGUA specification of the ontology..

1 Introduction

Researchers in the field of AI have recognised the explicit documentation of domain-theoretical assumptions as a valuable effort in its own right [*e.g.,* Wiederhold, 1994; Gruber, 1995]. This trend can also be seen in the legal domain. Moles and Dayal, for instance, argue that the AI and Law community should study the (implicit) 'assumptions being made *about the nature of law*' when making legal knowledge systems [Moles and Dayal, 1992, p.188]. The AI and Law community has not however shown a great interest in explicitly documenting such assumptions until recently, when two ontologies have been proposed for the legal domain: the functional ontology of law by Valente [1995], and the frame-based ontology of Van Kralingen [1995] and Visser [1995a].

In this article we focus on the specification of the latter ontology in a dedicated ontology language, called ONTOLINGUA (used also by Valente). We start by providing a brief discussion of ontologies and their merits (section 2), after which we discuss the legal ontology of Van Kralingen and Visser (section 3). Then we discuss the formalisation of the ontology (section 4). Finally, we provide a discussion and draw conclusions (section 5). The formal ontology - specified in ONTOLINGUA - is given in an appendix.

2 Ontologies

An ontology is an explicit conceptualisation of a domain, which describes the entities and relations taken to exist in the domain [Gruber, 1995]. It is considered a meta-level description with respect to knowledge models in that it describes the building blocks of these models [Van Heijst, 1995]. Thus, an ontology differs from these models because it only provides the elements with which the knowledge will be expressed in these models and not the knowledge itself. Typically, an ontology takes the form of a (hierarchically) ordered set of classes, instances, and relations. Ontologies can be useful in areas such as, domain-theory development, knowledge acquisition, system design, system documentation, and knowledge exchange [Visser and Bench-Capon, 1996].

Because domains can be conceptualised in many different ways, ontologies can differ quite substantially, even if the domains are conceptualised for the same purpose. Illustrative in this respect are the considerable discrepancies in the primary distinctions of the legal domain in McCarty's LLD (distinguishing: *atomic formulae*, *rules* and *modalities*; see [McCarty, 1993]), Stamper's NORMA (distinguishing: *agents*, *behavioural invariants*, and *realisations*; see [Stamper, 1996]), Valente's functional ontology of law (distinguishing: *normative knowledge, world knowledge, responsibility knowledge, reactive knowledge, meta-legal knowledge,* and *creative knowledge*; see [Valente, 1995]), and Van Kralingen and Visser's frame-based ontology (distinguishing: *norms, acts* and *concept descriptions*; see [Van Kralingen, 1995], and [Visser, 1995a]). All authors consider their conceptualisations suitable as the building blocks of the legal domain.

In most efforts to represent legal knowledge, vital assumptions about the conceptualisation of the domain are left implicit. The considerable differences in ontological distinctions (as illustrated above) stress the need to make conceptualisations explicit. To be able to specify a conceptualisation we need to have a specification language. There are a few languages tailored to expressing ontologies. The most commonly used ontology languages are CML [Schreiber *et al.*, 1994] and ONTOLINGUA [Gruber, 1992].

3 An informal description of a legal ontology

Van Kralingen [1995] and Visser [1995a] proposed an ontology for the legal domain. Their assumption is that robust conceptual and formal ontologies of the legal domain are necessities for reducing the task-dependency of legal knowledge specifications. In their collaborative project Van Kralingen has defined a conceptual ontology to model legal knowledge, and Visser has formalised this ontology (though not in ONTOLINGUA, see section 4). Although the ontologies of Van Kralingen and Visser are not fully identical, the abstraction level at which we discuss the ontologies here allows us to treat them as one. We here present an informal description of a compilation of both ontologies. We do not, however, elaborate on the ideas behind the ontological distinctions. For this, the reader is referred to previous work of the authors. The ontology contains two separate ontologies, the *generic legal ontology* and a the *statute-specific ontology*.

Generic legal ontology

The generic legal ontology distinguishes three generic structured entities in the legal domain. It divides legal knowledge into (*a*) norms, (*b*) acts and (*c*) concept descriptions. Below, we briefly discuss these three entities.

(*a*) *Norms* are the general rules, standards and principles of behaviour with which the subjects of law are enjoined to comply. In the ontology a norm comprises the following eight elements: (1) a norm identifier (used as a point of reference for the norm), (2) a norm type (either norm of conduct or norm of competence), (3) a promulgation (the source of the norm), (4) the scope (the range of application of the norm), (5) the conditions of application (the circumstances under which the norm is applicable), (6) the norm subject (the person or persons to whom the norm is addressed), (7) the legal modality (either ought, ought not, may or can), and (8) the act identifier (used as a reference to a separate act description).

(*b*) *Acts* represent the dynamic aspects which effect changes in the state of the world. Within the category of acts we make two distinctions. The first distinction is between *events* and *processes*. Events represent an instantaneous change between two states, while processes have duration. The second distinction is between *institutional acts* and *physical acts*. The former are legal (institutional) interpretations of the (physical) acts that occur in the real world (more precisely: an institutional act is a legal classification of a physical act). For example, the physical act of homicide may be any of the institutional acts of murder, manslaughter, or justifiable homicide. We note that these two distinctions result in four different types of acts. All acts are assumed to have the following fourteen elements: (1) the act identifier (used as a point of reference for the act), (2) a promulgation (the source of the act description), (3) the scope (the range of application of the act description), (4) the agent (an individual, a set of individuals, an aggregate or a conglomerate), (5) the act type (both basic acts, and acts that have been specified elsewhere can be used), (6) the modality of means (material objects used in the act or sub acts; *e.g.*, a gun), (7) the modality of manner (the way in which objects have been used or sub acts have been performed) (*e.g.*, aggressively), (8) the temporal aspects (an absolute time specification; *e.g.*, on the first of August, on Sundays, at night, etc, but not: during a fire, after the King dies, etc), (9) the spatial aspects (a specification of the location where the act takes place; *e.g.*, in the Netherlands, in Leiden, on a train), (10) the circumstantial aspects (a description of the circumstances under which the act takes place; *e.g.*, during a war), (11) the cause of the action (a specification of the reason(s) to perform the action, *e.g.*, revenge), (12) the aim of the action (the goal visualised by the agent; *e.g.*, with a view to unlawfully appropriate an object), (13) the intentionality of an action (the state of mind of the agent; *e.g.*, voluntary), and (14) the final state (the results and consequences of an action; *e.g.*, the death of the victim).

(*c*) *Concept descriptions* deal with the meanings of the concepts found in the domain. Concepts may be described by definitions or by deeming provisions; in either of which case their application can be definitively determined. In the case of definitions the description provides necessary and sufficient conditions. In the case of deeming provisions the description establishes a legal fiction. Finally, there are concepts described by factors, which either establish a sufficient condition or indicate some contribution to the applicability of the concept (to be considered in relation to other factors). Concept descriptions comprise the following seven elements: (1) the concept to be described, (2) the concept type (definition, deeming provision, factor), (3) the priority (the weight assigned to a factor), (4) the promulgation (the source of the concept description), (5) the scope (the range of application of the concept description), (6) the conditions under which a concept is applicable, and (7) an enumeration of instances of the concept.

Statute-specific ontology

The generic legal ontology contains constructs that are thought to be generic for the legal domain. That is, norms, acts and concept descriptions are considered to be present in any legal domain. However, modelling a particular legal domain involves not only deciding upon the general constructs, but also upon numerous detailed - and statute specific - ontological questions. For instance, is it necessary to distinguish between male and female employers in the Unemployment Benefits Act? Such questions motivate the distinction between the legal and the statute-specific ontology. Basically, the statute-specific ontology provides the vocabulary for describing the knowledge of the domain. It is used as an instantiation of the generic legal ontology. In contrast to the generic legal ontology, it cannot be reused for other domains, and must always be created for each legal sub-domain under consideration (though it should support various tasks in that sub-domain).

4 Formalising the legal ontology

The ontology presented in the previous section is an informal description of entities and relations taken to exist in the legal domain. The disadvantage of an informal description is found in its semantics. Informal descriptions are characterised by a lack of clarity. Also, to be able to compare different ontologies in the same domain it is convenient to express them all in the same 'standard' language. Only then can it provide a firm basis for comparison and criticism. For instance, the term of *Normative-Status* is contained both in our frame-based ontology (*viz.* as a function) and in Valente's functional ontology of law (*viz.* as a class). However, whereas the *Normative-Status* in Valente's ontology may take values *Allowed, Disallowed*, or *Silent* (referring to the modality of the norm), in our ontology it may take values *Breached* or *Not-Breached* (referring to the breach of a norm). A formal language that is intended as a standard ontology language is ONTOLINGUA (see section 2). The formal ontology discussed here differs from the formal ontology described in Visser [1995a] in three respects. First, in this paper we confine ourselves to the formalisation of the generic legal ontology because only this ontology is meant to be reusable (the statute-specific ontology is not formalised). Second, the ontology as presented in Visser [1995a] was not specified in a 'standard' ontology language. Here, we present a formal ONTOLINGUA specification of the ontology (given in the appendix). Third, the ontology in Visser [1995a] has much more detail than the one presented here (for reasons of reusability, see the discussion below).

Elaborating on all entities and relations in the ontology falls beyond the scope of this article. Instead, we confine ourselves to a discussion of the following four more general issues: (*a*) the structure of the ontology, (*b*) the ontology specification process, (*c*) the abstraction level of the ontology, and (*d*) the reusability of the ontology.

(*a*) *the structure of the ontology* Any ontology that is specified in ONTOLINGUA is expressed in terms of classes, relations, functions, instances, and axioms. Because expressing knowledge with only these low-level constructs can be rather inconvenient, ONTOLINGUA contains a library of predefined ontologies with useful high-level constructs. By including a predefined ontology in one's own ontology the terms defined in the former ontology become available in the new ontology. For instance, for the specification of our frame-based ontology we use the predefined 'frame ontology' of ONTOLINGUA, thus enabling us to use relations such as *subclass-of* and *slot-cardinality*. The use of such libraries also promotes the compatibility between different ontologies.

Our formal legal ontology consists of 18 classes, 2 relations and 1 function, there are no instances and axioms defined[1]. The main ontological distinction is the division of the class *legal knowledge* into three different kinds of frames (subclasses): *norm*, *act*, and *concept-description*. These frames all have a related set of slots, corresponding to the slots mentioned in the informal description (section 3). Most slots are defined to contain strings, but some slots are defined so as to have a instantiation from a predefined set. For instance, the slot *Norm-Type* (in the norm frame) has to be instantiated by a member of the set *Norm-Types* = {*conduct*, *competence*}, the latter set being a class in itself. The norm, act, and concept-description frame are subdivided into subclasses (sub frames). Thereby, the

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[1] Compare this with the ontology of Valente [1995], which contains 41 classes, 17 relations, 10 functions, 6 instances, and no (separate) axioms.

sub frames inherit the slots from their parent frames. Two relations are defined, *Event-Qualification* and *Process-Qualification*, both used to denote the qualification of a physical act as an instance of an institutional act. The function *Normative-Status* is used to state whether a particular norm has been breached or not.

(*b*) *the ontology specification process* Specifying the legal ontology in ONTOLINGUA is a process that is accompanied by a considerable amount of freedom [*cf.* Valente, 1995]. In our description we have chosen to make a hierarchical decomposition of the class of legal knowledge into subclasses and so on. Although this is a common strategy in the specification of an ontology it is not the only possibility. We could have opted, for instance, for a simple enumeration of the classes we would like to distinguish without relating them hierarchically. Also, in defining the hierarchy we made decisions that could have been made in another way without affecting the adequacy of the formal ontology (*viz.* to represent the knowledge types distinguished in the informal ontology). As an example, consider the class of acts. Acts are divided into physical acts and institutional acts, and these classes are both divided into (physical respectively institutional) events and processes. We could have modelled the class of acts as having subclasses events and processes, and divide these classes into their institutional and physical versions. Both alternatives would adequately model the informal ontology but would result in two different ontologies. Other, more technical choices have to be made as well. For instance, do we model a frame structure as a frame or as a class, do we model event and process qualifications as relations (as is done here), or as functions? Such decisions are arbitrary to a certain extent, and we will not elaborate on them here. We confine ourselves by stating that the informal ontology as described in section 2 can be implemented in different ways without affecting the adequacy of the ontology. Implications of the decisions are, however, revealed only by the formal ontology.

(*c*) *the abstraction level of the ontology* Related to the previous issue is the question as to at what abstraction level the ontology should be specified? The formal ontology given in the appendix covers the informal description as given in section 3. However, it must be stressed that both the (conceptual) ontology of Van Kralingen and the (formal) ontology of Visser have considerably more detail. Otherwise stated, the informal compilation of both ontologies given in section 3 does not cover all ontological distinctions made in Van Kralingen [1995] or Visser [1995a]. We have opted for an abstract description of the ontology to enhance reusability. We illustrate this choice by discussing a modelling dilemma, showing two competing arguments.

On the one hand, we could want a detailed ontology because such an ontology (*viz.* one that makes many ontological distinctions) is a useful tool in the acquisition and expression of domain knowledge. The various ontological distinctions provide a useful framework to determine what knowledge is relevant in modelling the domain knowledge (see also issue *d*). On the other hand, we could want a more abstract ontology because an abstract ontology is more likely to be reusable. This is motivated by the idea that the more detail is contained in an ontology, the more commitments are made to particular tasks, methods and (sub)domains. Creating a ontology, either conceptual or formal, implies that commitments have to be made concerning the tasks, methods and domains under consideration. The nearer an ontology gets to its implementation, the more such commitments are contained in the model. The more detailed an ontology, the less likely it is to be reusable for arbitrary tasks, methods and (sub)domains [Visser, 1995a]. In conclusion, we believe that there is no generally desirable abstraction level that should be chosen for the expression of an ontology. The abstraction level we have chosen is to be considered a compromise between these two competing arguments.

(*d*) *the reusability of the ontology* As stated in the discussion on the abstraction level of the ontology, our decision to specify the ontology at an abstract level, rather than at a detailed level is motivated by a higher reusability. To illustrate the reusability of the legal ontology, we briefly discuss four examples in which the ontology (*viz.* the ontological distinctions) are used.

The first example concerns the use of the ontology for an *assessment system*. Visser [1995b] has implemented a prototype legal knowledge system, called FRAMER, that performs assessment tasks on the Dutch Unemployment Benefits Act. The domain knowledge in the PROLOG prototype is structured according to the ontological distinctions made in the legal ontology.

The second example concerns the use of the ontology for a *planning system*. The domain knowledge of the assessment system described above has been designed so as to support multiple legal tasks [Visser, 1995a]. Apart from the assessment task, the FRAMER system also performs a planning task on the same domain specification [Visser, 1995b]. Because the domain knowledge is reusable for the planning task, we may consider the ontology to be reusable for a planning task as well.

The third example concerns the use of the ontology in *structure preserving representation* of law. Peek [1995] has adopted the ontology to represent law as so-called 'feature structures' [*e.g.,* Shieber, 1986]. Although Peek did not use the ontology as such, he implemented the same theoretical distinctions made in the ontology. For this reason we consider the work of Peek as an example of the use of the ontology.

The fourth example concerns the use of the ontology in the process of *drafting regulations*. Voermans [1995] has used the ontology for his LEDA system. LEDA, which is considered to be an information system rather than a knowledge system, implements guidelines of the Dutch Ministry of Justice for drafting regulations. The ontology, that is, the distinctions made in the ontology, are used to guide the knowledge-acquisition process (see: ontology application area 2, section 2).

5 Conclusions

In this article we discussed an informal ontology of the legal domain and its formalisation in ONTOLINGUA. The main conclusions derived from this study are:

- The specification of an ontology is accompanied by a considerable amount of freedom;
- There is a trade off between the reusability (*viz.* abstract ontologies) and the knowledge-acquisition support (*viz.* detailed ontologies) of an ontology;
- Ontologies are reusable components of legal knowledge systems.
- Ontologies written in a common formalism facilitate the comparison of different conceptualisations.

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Appendix: ONTOLINGUA specification of the legal ontology

```
(In-Package "ONTOLINGUA-USER")

(Define-Ontology
   Legal-Ontology
   (Frame-Ontology)
   "This is the ONTOLINGUA specification of the (generic) legal ontology as described by Van Kralingen
   (1995) and Visser (1995a)."
   :Io-Package
   "ONTOLINGUA-USER"
   :Intern-In
   ((Frame-Ontology Arity Thing Subclass-Of Class Instance-Of Documentation
          Slot-Cardinality, Slot-Value-Type)
    (Kif-Extensions String)
    (Kif-Numbers Number)
    (Kif-Sets Member)))

(In-Ontology (Quote Generic-Legal-Ontology))

;;; ------------------ Classes --------------

;;; Act
(Define-Frame Act
   :Own-Slots
```