A Formal Method for Interpretation of Sources of Norms

Robert van Doesburg

Leibniz Center for Law, University of Amsterdam, The Netherlands

robertvandoesburg@uva.nl

Abstract. The subject of this paper is a research project that aims to create a standardized method for expressing the interpretation of normative texts in natural language into a formal representation in machine readable and executable form. It gives an overview of the results and the context of the project. This paper aims to give a foundation for a discussion on research on the formal interpretation of sources of norms during the ICAIL 2017 Doctoral Consortium.

Keywords: AI and Law, interpretation, normative systems, argumentation.

1 Introduction

The field of artificial intelligence (AI) and law is all about legal knowledge acquisition and the use of that knowledge by agents to achieve goals. To be able to do so there is a need to know relevant sources of norms, to have a formal interpretation of those norms, and to have a reasoner that can apply the formal interpretation of these norms to the behavioral context of the agents involved.

Because norms are made by humans and, mostly, expressed in (written) natural language, AI and Law is also about the border between essentially human tasks, and tasks that can be performed by a non-human agent. In our research, we address that border.

Engineering challenge. Create a standardized method for expressing the interpretation of normative texts in natural language into a formal representation in machine readable and executable form.

Research Questions. To meet the engineering challenge, research questions are formulated, some of those are listed below:

1. What's wrong with existing methods for the interpretation of normative texts in natural language?
2. What knowledge does a normative reasoner need to be able to determine the behavioral context of all potentially involved agent in a regulated system?
3. How to acquire knowledge needed by a reasoner in a normative system from normative sources in natural language?
4. How to handle differences in the interpretation of normative sources caused by inherent ambiguity of statements in natural language?

Content of this paper. In this paper, we will focus on the creation of a standardized method for the formal interpretation of normative texts in natural language.

In section 2 we will give a short overview of the foundations of the method, i.e.: three layers of reality based on the work of John Searle on social reality (1); Hohfeld's fundamental legal concepts (2); the four main approaches for the acquisition, representation and use of legal knowledge (3), theories on norms and arguments (4).

In section 3 we will give a short presentation of our work on the formal interpretation of normative texts in natural language. In section 4 we will discuss the results of my work until now and the work that needs to be done to meet our engineering challenge.

2 On the representation of norms

2.1 Three layers of reality

In our approach, we separate three layers of reality that are interconnected. This model is an extended version of the three layers of reality model presented in [12]. The model is based on the work of John Searle on the construction of social reality [18]. The three layers of reality are:

1. Sources of Norms (This layer describes the components, structure and referential mechanisms that allow us to refer to the natural language sources describing the norms we want to 'translate' into formal computational models.)
2. Institutional Reality (This layer describes the interpretation of the sources of norms in the previous layer, using: states representing situations; legal positions; and acts regulated by norms. In this paper, we focus on this layer.)
3. Social Reality (The Social Reality layer describes agents, agent-roles, collaboration of agents, coordination, message passing, and other behavioral aspects of agents. This layer is used to describe and simulate behavior in societies regulated by norms. These norms can be used, e.g., to test (non-) compliance scenarios, and to predict effectiveness.

2.2 Fundamental legal concepts

The method for modeling the institutional content of normative sources is based upon the work of Wesley Newcomb Hohfeld, who introduced a set of fundamental legal conceptions in 1913, see Hohfeld and Cook [15]. Hohfeld's conceptualization of norms was meant to provide a solution for the ambiguity of the concepts 'right' and 'duty'. Hohfeld introduced a smallest set of legal conceptions to which, according to him, any and all 'legal quantities' could be reduced. But while Hohfeld was mainly aiming at understanding the positions between two adversarial parties in law cases, we aim to describe, analyze and understand (the consequences of) normative systems in general. This obviously includes individual cases consisting of two adversarial parties.

Hohfeld distinguished four fundamental legal conceps: *power-liability relations* (1), *immunity-disability relations* (2), *duty-claimright relations* (3), *liberty-noclaim relations* (4).

In our work, we address norms in general, including policies and social norms, therefore we use the term normative relations instead of legal relations.

The Hohfeldian legal conceptions can only exist in pairs and describe relations between two people, each holding one of the rights in a pair. The *power-liability relation* and *immunity-disability relation* are generative: they can generate new normative relations. The *duty-claimright relation* and *liberty-noclaim relation* are situational: they can only be created and terminated by an act based on a generative normative relation. Both pairs are mutually exclusive. If person A is in a situation in which he has the power to perform act X, and person B has a liability towards the result of that act, person B cannot have a disability (the absence of a power) to perform act X in that same situation. The *power-liability relation* excludes the related *immunity-disability relation*. The same goes for the situational normative relation. If person A has the duty to perform act X, and person B has a claimright towards the result of that act, person A cannot have a liberty (the absence of a duty) to perform act X in that same situation.

Hohfeld's fundamental legal concepts can be used to describe any possible normative relation or normative position [2] [24].

2.3 Four approaches for legal knowledge engineering

Valente describes three types of approaches for legal knowledge engineering [22]. In 1995 Van Kralingen [16] added a fourth approach, the frame-based approach. All approaches provide the knowledge engineer with a specific perspective or ontological framework, on original sources of norms. Below we give a short description of the characteristics of the four approaches.

The rule-based approach. The main assumption behind the rule-based approach is that legislation can be represented as production rules, e.g. having the form of 'if A, then B' or 'if A, then add B'. These production rules can be used in two ways in AI and Law: as a model of normative sources and when combined with a reasoning engine as an implementation device. Production rules are a shallow representation device for law, because they do not grasp important epistemological distinctions in law. According to Valente [22] the practice of this rule-based approach is that a large part of the systems developed, are highly pragmatic and ad-hoc. Deficiencies come from the absence of any theoretical foundation and the use of an oversimplified development strategy. Since 1995 there has been some progress on this subject, but the interpretation of normative sources in natural language remains problematic, see also [5][17][25]. The rule-based approach is suitable for developing executable models for a given set of formalized norms. The approach has no solution for extracting formalized rules from normative sources in natural language.

The case-based approach. The case-based approach represents laws as cases and uses cased-based reasoning techniques to reason with them. These techniques are being used to model analogical reasoning, or rather to solve actual problems (cases) by retrieving similar past cases and using them to solve the one at hand. The classical example of case-based reasoned used in law is HYPO [3]. This process mimics the behavior of trial lawyers in the USA, and it is successfully used to model cases in this context [22].

While researchers working on the case-based approach have suggested methods to extract legal knowledge from cases, no solution has yet been proposed for the extraction

of formal legal knowledge from statute law, regulations and other not case-centered normative sources in natural language.

The logic based approach. The truth-based, or logic based approach, is an important and omnipotent approach for Legal Knowledge Engineering. Logic and truth maintenance systems have been the first formalizations that could run on digital computers, thanks to the fundamental work of Claude Shannon [19]. Logic has been used for reasoning (modeling inferences, implementing these and analyze their computability, or complexity), justification (is this reasoning valid), and representation (domain representation and representing ontological commitments).

Logics are also often used in the rule-based and case-based approaches. In the process of interpreting normative sources in natural language, however, logic has its downsides. The most important of these is that domain experts in the legal field are unfamiliar with logical formulas, especially with the complex non-standard approaches that are being used to represent normative systems [22].

The frame-based approach. While one of the founding fathers of AI, Marvin Minsky, already introduced the term 'frame' as a concept essential for knowledge representation, Van Kralingen [16] suggested to use a frame-based approach for legal knowledge engineering. Although he failed to explain how these frames should support reasoning, he claims that they are inherently suited for making interpretations of sources in natural language. Van Kralingen explicitly writes in his theses that he is not paying attention to problems associated with the interpretation of legal knowledge [16].

In the 2009 Breaux [6] made his own frame for analyzing normative sources, without referring to the work of Van Kralingen. With his approach, Breaux aimed at supporting knowledge engineers that build legal reasoning systems and consequently named his approach a Frame-Based Requirements Analysis Method.

The frame-based approaches of Van Kralingen and Breaux use their frame to assign text fragments from sources of norms to frames. If a specific frame element cannot be found in a sentence, or set of sentences, then that frame element remains empty. Also, both approaches lack a well-structured solution for defining the result of an act, sometimes even resulting in acts that are defined as 'state-of-affair' [16].

Therefore, these approaches are not suited to meet the engineering challenge. We believe the frame-based approach is very suitable for making interpretations of sources of norms. Fine tuning is needed to get to a method that is: Addresses problems associated with the interpretation of legal knowledge (1), and results in a formal interpretation in machine readable and executable form (2).

2.4 Norms and arguments

In 1958 Toulmin introduced the argumentation scheme [21]. The instrument is frequently used in the AI and Law community. We recently started using argument scheme to structure discussions on conflicting interpretation of sources of norms [10]. More work on this subject needs to done to incorporate recent adjustments in this domain, especially concerning IT-support for the creation of argument schemes.

3 A method for the interpretation of normative texts in natural language

Our perspective on the interpretation of normative texts follows from the goals we want to achieve by using these models, e.g.:

1. To understand the consequences of sources of norms for all addressees.
2. Allow for a discussion on the interpretation of sources of norms expressed in natural language in a precise way.
3. A large-scale applicable method supporting knowledge engineers in translating these sources of norms into a formal, machine readable and executable representation, thus overcoming ambiguity issues of natural language and allowing for IT-support systems for various tasks.

Combining these purposes with Searle's distinction between social and institutional reality, results in a focus on agents, social reality (agent roles, and behavior), institutional reality (facts, normative positions and acts) and mapping functions between these two layers of reality (qualification).

When you create a formal representation of a source, the first thing you are faced with is the bootstrapping problem: where to start? Different solutions have been proposed in the past, but most authors remain vague about this particular point. Experience in the POWER project [14] shows that it doesn't make sense to start with the first sentence and then work your way to the end of it, if only for the fact that the sources are to voluminous, and contain references to equally voluminous additional sources, and so on and so forth. This leads to a task that cannot be completed.

We need a more practical useful approach. Unfortunately, this comes at the cost of dropping a completely task independent representation: the boundaries of the resulting model are impacted by the chosen task. The interpretation model itself however, can be made task independent. In other words, the model may be used for a variety of tasks, although it may still be incomplete. The goal of making an interpretation is not to create a complete model that results in the correct answer to any question. The goal is to make a model that can be used a specific set of questions.

This brings us to the stopping criteria. This will always remain a question open for debate. There may be new questions or tasks, that require additional sources of norms to be included. There may be changes to sources of norms, already in the interpretation model. And of course, there also me appear new interpretations of existing sources of norms.

Procedure for making an interpretation model.

1. Decide which task(s) are to be supported.
2. Find an initial set of relevant sources of norms.
3. Identify an initial set of relevant fragments for the task(s) at hand.
4. Transform relevant fragments into an explicit interpretation model.
5. If necessary, find additional sources and fragments to fill missing information.
6. Make explicit expressions for all assumptions left implicit by the authors of the sources of norms.

The Formal Language for the Interpretation of Normative Theories: Flint. The basic concept of Flint is that a norm regulates an action of a person (or an agent). We started to interpret sentences from normative sources as Hohfeldian normative relations. Sentences using fragments like 'our minister can reject the application' were considered to be a *power-liability relation*. We made standard sentences to transform sentences from sources of norms, into Hohfeldian frames [8] [11][13]. When a frame was not complete, we assumed that information needed to act according to the norms, was missing. If fragments filling this shortcoming, are not found, we assume that the source of norm contains implicit information, and we choose an explicit expression that, we think, fits the meaning of the interpreted sources of norms best.

Allen, who developed logical expressions for making interpretations of norms in natural language [2], chooses another approach. In [1] he distinguishes 1.344 possible interpretations First Amendment to the United States Constitution. Though technically correct, Allens result does not give an operational perspective for people that want to comply to the law. It does show the ambiguities in natural language text, and the result can be used to reduce ambiguity in future texts. By making an explicit choice for one interpretation, the behavior of actors can be explained. Furthermore, by making the interpretation explicit, the interpretation is open for discussion. Arguments for different interpretations, can be presented, conflicting interpretations can be debated, resulting in consensus or a decision by an arbitrator.

The Flint-language for the interpretation of sources of norms was developed initially during a NWO sponsored workshop [8], which has led to a continuing collaboration between academics and industry. It consists of a domain specific language (DSL) and a prototype that supports working with this language. During the Lorentz Workshop 'Normware: Modeling Norms and Automated Norm Application' [9] we created a prototype that can generate a datalog reasoner from a Flint-language interpretation model. After this workshop, we choose to simplify the Flint frames. Software engineers and legal experts both expressed complaints about the use of Hohfeldian relations to express normative interpretation. Software engineers had the opinion that the Hohfeldian relations contained redundant information. Legal experts, at least in the Netherlands are mostly unfamiliar with the work of Hohfeld, and did not recognize the expressions. The result was framework consisting of three frame types, see table 1.

Table 1. The Flint-language framework.

Institutional act frame	**Duty-claimright frame**	**Institutional fact type frame**
Act	Description of duty	Institutional facts
Actor	Holder of duty	Derivation function
Object	Holder of claimright	
Recipient	Creating institutional act	
Precondition	Terminating institutional act	
Creating postcondition		
Terminating postcondition		
Reference to source(s)	Reference to source(s)	Reference to source(s)

The institutional act frame, expresses an act described in a natural language norm. The source must in any case consist of the elements presented in table 1. If there is an act, there must be an actor, and an object that is acted upon. The act is allowed by the norm if in the initial state the precondition of the institutional act is met. And the result of the act is a postcondition that differs from the initial state because new facts are created, and/or existing fact are terminated. The duty-claimright frame contains the description of the duty, the holder of the duty, the institutional act(s) that can create or terminate a duty-claimright frame. The institutional fact frame is used to make a detailed expression of the precondition of institutional acts. The traceability of the sources of norms are secured by references using the MetaLex standard [7].

The framework is being used to enable experts from the legal, policy and administrative domain to explicitly formulate their interpretation of a normative source, while knowledge engineers can focus on the formal aspects of the expression.

An example. In [10] we analyze the regulation of the withdrawal of objections to government decisions. We did this to show how are method for the interpretation of sources of norms could help to overcome differences of opinion within the Dutch Ministry of Finance on this subject. The main position was that an objection can only be withdrawn in writing, or orally during a hearing. While some experts pointed at case law that also allows the withdrawal of an objection under specific conditions. Table 2 and the argumentation scheme below gives a glance at the use of the Flint framebase and the use of argument schemes to capture the exchange of opinions on an interpretation.

Table 2. Interpreting sources of law concerning the withdrawal of objections to a decision

Sources of Law	**Interpretation of sources of law**
Article 1:5 section 1 GALA "'Lodging an objection' means exercising the right conferred by law to request the administrative authority that took a decision to reconsider it."	*Institutional act* Act: [to withdraw] Actor: [submitter] Object: [objection] Recipient: [administrative authority] Precondition: [in writing] OR [orally at hearing] Creating postcondition: none Terminating postcondition: [objection]
Article 6:21 GALA 1. "An objection or appeal may be withdrawn in writing. 2. It may also be withdrawn orally at a hearing."	
Case law *ECLI:NL:RBDHA:2016:6098* "The power to withdraw an objection lies exclusively with the person that lodged the objection."	

The ruling ECLI:NL:GHSGR:2009:BI4839 contains the following sentence: “It must be assumed that a withdrawal of an objection made by telephone [in a conversation that is not a hearing], lies within the scope of Article 6:21, paragraph 2, GALA, provided the administrative authority sends a written confirmation to the submitter, the submitter agrees and the procedure is sufficiently carefully performed.”

Claim	An objection can only be withdrawn in writing, or orally during a hearing.
Data	An objection is withdrawn.
Warrant	Article 6:21 GALA: An objection or appeal may be withdrawn in writing (1). It may also be withdrawn orally at a hearing (2).
Rebuttal	An objection can be withdrawn during a telephone conversation that does not qualify as a hearing, provided the administrative authority sends written confirmation of the withdrawal and the submitter agrees with the written confirmation.
Neutralizer	The withdrawal during a telephone conversation lies within the scope of Article 6:21, paragraph 2, GALA. Therefore, legally it can be considered a to be equal to an oral withdrawal at a hearing.
Rebuttal to neutralizer	The statement that an objection can only be withdrawn in writing, or orally at a hearing, referred to an ‘actual act’ and not to a ‘legal qualification’.

4 Discussion and conclusion

What’s new. The authors consider the following aspects of their work a contribution to the field of AI and Law:

1. A first version of a procedure for knowledge engineers to start and stop the process of modelling sources of norms. The authors do not claim completeness of the resulting interpretation model. All interested parties are invited to argue that not all relevant fragments of sources of norms are included, and/or that the interpretation of these fragments should be changed.
2. Separating the interpretation of norms from the application of that interpretation on specific cases (actual or imaginary). In rule-based, case-based, logic based, and in the frame-based approaches by Van Kralingen and Breaux do not make this distinction. By making this distinction we enable to distinguish between:
   a. the relevant sources of norms and the fragments thereof for regulating a specific (set of) task(s)
   b. the interpretation of a set of fragments from sources of norms
   c. the facts and acts of a specific case
   d. the mapping of the facts and acts in a specific case on institutional facts, or institutional acts in the interpretation model.
3. The formal interpretation models allow for applying argumentation schemes to structure differences of opinion on the interpretation of norms and norms applied to cases. Argument schemes are usually applied only to claims concerning specific cases (“Harry must be a British subject”) [21][23]. The use of argumentation

schemes for interpretation models results in alterations in the standard scheme. For example: the qualifier for an explicit interpretation model must be ‘always’. The discovery of exceptions will not result in a change of the ‘qualifier’ in the argument scheme. If the exception is recognized by the owner of the interpretation model, the interpretation model will be changed accordingly. An exception to a certain norm may lead ti including the exception conditions in the precondition of relevant constituents of the interpretation model.

4. All the previous contributions enhance transparency. This also substantially decreases the complexity of the validation of the interpretation models.

Results.

1. A procedure for making an interpretation model.
2. Frames for institutional acts, duty-claimright relations, institutional facts.
3. A DSL for the formal interpretation of normative sources (Flint) [11].
4. A prototype for generating a datalog reasoner from a Flint representation of a simplified example in the tax domain [9].
5. An interpretation model for decisions of the Dutch Immigration and Naturalization Service on applications for a residence permit for students and knowledge workers.
6. First experiment with argumentation schemes for the interpretation of sources of norms [10].

Conclusion. This paper gives an overview of the research I have been doing in the past years to solve the engineering challenge to create a standardized method for expressing the interpretation of normative texts in natural language into a formal representation in machine readable and executable form. The research project resulted in a procedure for the interpretation of normative text in natural language and a DSL to express interpretation into a formal representation in machine readable and executable form. A first prototype for a reasoner generated from a frame-based interpretation has been tested.

Future work will focus on the following subject: Evaluation of the method and the resulting interpretation models by experts and laymen and experts from the fields of law, policy advising, public administration, knowledge engineers (1). Adding recent developments in the field of argumentation theory (2). Relating the Flint-language solution to the work that has been done in the field of legal knowledge engineering (3). Development of tooling for modelers, including comprehensive views for various domain experts (4).

References

1. Allen, L.E, Tury, A.W.,: NewMINT interpretation ssistance system: United States Constitution First Amendment’s Initial 1344 interpretations. In: ICAIL '07, pp 161-165, ACM, USA, (2017).
2. Allen, L.E., Saxon C.S.: Analysis of the logical structure of legal rules by a modernized and formalized version of Hohfeld fundamental legal conceptions. In: Martino, A.A. and Natali, F.S. (eds), Automated Analysis of Legal Texts, pp. 385–450, (1986).
3. Ashley, K.: Modelling Legal Argument: Reasoning with Cases and Hypotheticals, MIT Press, Cambridge MA, (1990).

4. Bench-Capon, T., et al.: A history of AI and Law in 50 papers: 25 years of the international conference on AI and Law. In: Artificial Intelligence and Law, vol. 20(3), pp. 215-319, (2012).
5. Boella, G. et. al.: A Critical Analysis of Legal Requirements: Engineering from the Perspective of Legal Practice, IEEE 7th International Workshop on Requirements Engineering and Law (RELAW), pp. 14-21, Karlskrona, Sweden (2014).
6. Breaux, T.D.: Legal Requirements Acquisition for the Specification of Legally Compliant Information Systems, PhD thesis, North Carolina State University, Raleigh (NC), 2009.
7. CEN MetaLex. Open XML Interchange Format for Legal and Legislative Resources. http://www.metalex.eu., last accessed 2017/06/01
8. Doesburg, R. van, et al.: Towards a Method for a Formal Analysis of Law, Study Case Report ICT with Industry workshop 2015', NWO (2016). https://www.nwo.nl/over-nwo/organisatie/nwo-onderdelen/ew/bijeenkomsten/ict+with+industry+workshop/proceedings, last accessed 2017/06/01.
9. Doesburg, R. van, et al.: Normware: Modeling Norms and Automated Norm Application, to be published.
10. Doesburg, R. van, , Engers, T. van,: Arguments on the Correct Interpretation of Sources of Law. In: AICOL2017, to be published.
11. Doesburg, R. van, Storm, T. van der, Engers, T. van,: CALCULEMUS: Towards a Formal Language for the Interpretation of Normative Systems. In: AI4J Workshop at ECAI 2016, The Hague, (2016).
12. Engers T.M. van, Boer, A.: Public Agility and Change in a Network Environment. In: Schossboeck, J., Edelmann, N., Parycek, P. (eds), JeDEM 3(1), pp. 99-117, (2011).
13. Engers, T.M. van, Doesburg, R. van,: Modeling the Interpretation of Sources of Norms. In: proceedings of eKNOW2016, IARIA XPS Press, pp. 41-50, (2016).
14. Engers, T.M. van, Kordelaar, P.J.M., Hartog, J. den, Glassée, E.: POWER: Programme for an Ontology based Working Environment for modeling and use of Regulations and legislation. In: Tjoa, Wagner, Al-Zobaidie (eds), Proceedings of the 11th workshop on Databases and Expert Systems Applications (IEEE), Greenwich London, pp. 327-334, (2000).
15. Hohfeld, W.N., Cook, W.W: Fundamental legal conceptions as applied in judicial reasoning, and other legal essays. Yale University Press, New Haven (CT), (1919).
16. Kralingen, R.W. van,: Frame-based conceptual models of statute law. Kluwer, (1995).
17. Maat, E. de, Winkels, R., Engers, T. van,: Making sense of legal texts. In: Grewendorf, G., Rathert, M. (eds.). Formal linguistics and law Vol. 212, pp. 225-255, Berlin, (2009).
18. Searle, J.R.: The construction of social reality, Penguin Books, London, (1996).
19. Shannon, C.E.: A Mathematical Theory of Communication. Bell System Technical Journal, vol. 27(3), pp 379–423, (1948).
20. Sileno, G., Boer, A., van Engers, T. M.: Commitments, expectations, affordances and susceptibilities: Towards positional agent programming. In: PRIMA 2015, pp. 687-696, (2015).
21. Toulmin, S. E.: The Uses of Argument, Cambridge University Press, Cambridge (1958).
22. Valente, A.: Legal Knowledge Engineering: A modeling approach. IOS Press, Amsterdam, (1995).
23. Verheij, B.: Evaluating arguments based on Toulmin's scheme. Argumentation, 19(3), pp. 347-371 (2005).
24. Wenar, L.: The Nature of Rights. In: Philosophy& Public Affairs, vol. 33(3) pp. 223-252 (2005),
25. Wyner, A., Engers, T. van, Hunter, A.: Working on the argument pipeline. In: Argument and Computation, vol. 7, pp 69–89 (2016)