Ontology Evolution in Legal Reasoning: A study of ontology interpretation (Extended Abstract)

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Abstract.

We are researching the problem of open texture in legal reasoning and how it leads to the evolution of legal ontologies. Concepts in law are open-textured, they can't be uniquely matched to common sense concepts which describe real-world events. The argumentation that occurs in many legal cases is about the meaning of legal concepts. These legal concepts evolve through this argumentation. Our aim is to build computational models of this legal reasoning. We argue for the importance of ontologies for meta-knowledge in modelling this argumentation. We also argue that this work has relevance for ontology matching.

1 Legal Reasoning and Open Texture

Legal reasoning is not simply a matter of identifying the subsumptions between legal concepts and real-world concepts. Legal concepts are not precisely defined enough for this: the relationship between them and the real-world is not exact. H.L.A. Hart, who was the first to explicitly describe this phenomena[1] [5], gives the example of a legal rule governing a park: "No Vehicles in the Park". The rule seems clear enough, but what about the situation where a child wants to ride his bike in the park? Does the definition of "vehicle" in the rule include bikes? Hart argued that legal rules have a core meaning which we agree on, e.g. a car or a lorry is a vehicle, but there is also a fringe of uncertain cases where we are not sure whether we can, or should, apply the rule. These cases are hard legal cases, where lawyers must argue for their preferred interpretation and judges must best resolve the open-texture.

There is an analogy between the problem faced by a lawyer using the law and that faced by an agent using an ontology. The lawyer did not create the law, but must find a match between the legal concepts and the real-world situation. For instance, a lawyer must argue why "vehicle" should or should not include "bike". Similiarly, an agent must use an ontology (which they probably did not create) and find matches between it and the ontologies used by other agents. For instance, an agent might have to find a match between "automobile" and "motor vehicle". The legal problem can be viewed as a matching problem between an abstract legal ontology and a commonsense real-world ontology.

Legal reasoning is different from the reasoning that currently occurs in ontology matching because of its reflective nature. Lawyers do not just argue about the meaning of legal concepts, they can also argue about how legal concepts acquire meaning. For instance, in the case of *James Buchanan and Co Ltd v. Babco Forwarding and Shipping (UK) Ltd*[2] lawyers argued over the meaning of "other charges incurred in respect of the carriage of the goods". In trying to determine a meaning for the phrase, they had to argue about how the phrase could acquire meaning in the context of the case. The law was based on an international treaty, and there was a French language version of the law, in addition to the version enacted in English law. The lawyers argued about whether the meaning of the French law could be used to help interpret the meaning of the English law. The methods they were using to determine the meaning of the term were part of the domain of argumentation. Contextual information is already used to aid ontology matching, e.g. the S-Match system [3], what differs here is the reasoning *about* the rules for using those contextual sources.

2 Ontology Evolution

Legal rules and concepts evolve because of the argumentation about their meaning. This is particularly obvious in a common-law legal system in which precedents are binding. So if a case decided that "vehicle" should not include a child's bike, in future children would be safe to cycle through the park. The meaning of "vehicle" has changed in this context to exclude bikes, at least when they are ridden by children.

The arguments about the meaning of a legal concept depend upon meta-theories of knowledge and meaning. The arguments involve meta-ontological concepts such as "includes" or "depends upon". For instance, a lawyer might argue: "the definition of vehicle depends upon the maximum speed the object is capable of, since vehicles travelling slower than 5 miles per hour aren't a danger to the public." This argument contains an assertion about what the definition of vehicle should be. This can be viewed as an assertion about the definition of the vehicle concept:

$Vehicle(x) \rightarrow maxspeed(x) > 5mph$

This definition is justified by the argument that the concept of "vehicle" was intended to prevent dangerous situations and that a vehicle whose speed is less than 5 miles per hour is not dangerous. But another lawyer could challenge this justification. They could argue that the law was intended to prevent bikes from damaging the grass, so any bike should be banned from the park.

We can see from this example that evolution of the meaning of the legal concept is driven by the arguments that are created by the lawyers and that are accepted by the judge. The lawyers are motivated to create these arguments because they want to win the case, the judge is motivated to find the "best" legal solution to the problem. Naturally the judge is the hardest agent to model in this case, since we have no algorithm to determining the "best" legal solution. However, the lawyers can be modelled as agents which have the goal

[1] Although Hart's work is influenced by philosophical work on meaning in natural language by Wittgenstein and Waissmann.

[2] [1978] A.C. 141

of winning the case for their client, they must find "good" legal arguments from the various contextual sources which they have available. The challenge of developing a computational model is to give some operational definition of what good is and to prepare the background knowledge necessary to generate the arguments.

3 Computational Model

We are using work on contextual logics [1] as a basis for our formalisation of legal reasoning. Our computational model is based upon the idea of legal reasoning as contextual theory construction. An agent has to create a $Theory$ context which contains arguments which justify an interpretation of the open-textured legal rule. The arguments are based upon the content of other contexts and the bridge rules for composing them.

For example, an argument about the meaning of vehicle might look like:

$$\begin{aligned} Park : \forall x.Vehicle(x) \wedge inPark(x) &\rightarrow Fine(rider(x)) \\ RealWorld : bike(bike01) &\wedge inPark(bike01) \\ Commonsense : \forall x.bike(x) &\rightarrow Vehicle(x) \\ &\vdash Fine(rider(bike01)) \end{aligned}$$

This argument states that since: the $Park$[3] context states that if a vehicle is in the park then its owner should be fined; the $RealWorld$ context states that the bike $bike01$ is in the park; and a $Commonsense$[4] context states that any bike is a vehicle; then we can conclude that the the bike rider should be fined.

The problem of developing a theory is one of taking various contextual background knowledge sources and using them to create a set of arguments which justifies either applying the law or not in a particular real-world situation. We would like to develop a system which will take in relevant background knowledge to a legal case, and a description of the real-world situation and the law; the system will then try to find arguments for both sides from the background knowledge that would justify applying the law to the real-world situation. The process of finding arguments uses the contextual and meta-level reasoning to argue about how the law can (and should) be interpreted.

The main challenge is to develop the ontologies to describe the meaning of legal rules and the meta-level reasoning required to reason about meaning. The ontologies about meaning must also relate with the facts of a legal case, so we can bridge between what happened and an argument about how the law should be interpreted.

4 Related Work

Our work is closely related to work on contextual reasoning within A.I. and work on open-texture within A.I. and Law. We have been using a model of context developed by researchers at the University of Trento [2]. However the examples normally used to motivate research into contextual logics, e.g. the magic box example [2], are not very complex; there is a large gap between them and real-world contextual reasoning, which our research is helping to bridge.

There has been some research into the problem of open-texture within the AI and Law community. Most of this work has focused upon the use of defeasible reasoning[5] to represent and reason about the exceptions to a legal rule. The most similiar work was done by Andreas Hamfelt [4], who used meta-logic programming to formalise the multiple levels of legal rules and how these can determine the interpretation of a legal rule. In particular, he used a meta-ontological predicate "Meaning" to formalise the relationship between a natural-language legal-rule and a formal representation of the rule.

[3] a context which represents the content of a park bylaw

[4] representing a context of background commonsense knowledge which a lawyer can appeal to

[5] related to the fields of non-monotonic logic and argumentation

5 Conclusion

We have presented a brief description of our research into modelling ontology evolution in law and how it relates to problems in ontology matching. Our model is based upon contextual reasoning in which a legal agent must reason about how bridge rules between contexts can be used to create a theory regarding the interpretation of an open-textured legal rule.

REFERENCES

[1] Bouquet P. Benerecetti M. and Ghidini C. Contextual reasoning distilled. *Journal of Experimental Artificial Intelligence*, 12(3):279–305, 2000.

[2] C. Ghidini and F. Giunchiglia. Local Models Semantics, or contextual reasoning= locality+ compatibility. *Artificial Intelligence*, 127(2):221–259, 2001.

[3] F. Giunchiglia, P. Shvaiko, and M. Yatskevich. S-Match: an Algorithm and an Implementation of Semantic Matching. *Lecture Notes in Computer Science Volume 3053*, pages 61–75, 2004.

[4] A. Hamfelt. Formalizing multiple interpretation of legal knowledge. *Artificial Intelligence and Law*, 3(4):221–265, 1995.

[5] HLA Hart. The Concept of Law, Clarendon Law Series, 1961.