

Title	不完全知識下での類推解釈を支援する法的推論システムの研究
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A Legal Inference System to support legal analogy under incomplete knowledge

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In this thesis, we describe a method for inference of discovery in legal inference. Logical Jurisprudence separates legal inference into the inference of justification and the inference of discovery. The inference of justification is the process to justify from the premises regarded to true legally, and the inference of discovery is the process to discover the judgment and premises. In Logical Jurisprudence, these inferences cannot miss in legal inference, because in case lawyers deliver a judgment, these inferences make up for a lack of knowledge to execute inference in the other side. In these methods of inference, the inference of justification can realize with deduction, however the inference of discovery cannot realize with deduction, therefore it needs to extend a method for inference. In the field of Artificial Intelligence, many studies are done concerned with the inference of discovery using elements to extend the inference, however, most of these studies have several problems as regards its framework for realization of legal inference, for example, the range of possible inference was restricted, or it isn't enough to sort out legal knowledge.

In order to improve these problems that past studies have, we pay attention to abduction and analogy. Abduction is a method of inference, Peirce distinguished abduction from deduction or induction for the first time, he says that abduction is the inference for looking for explanations, and he also says that abduction is the process for generating hypotheses and explanations. Furthermore, abduction is available to realize the inference under incomplete knowledge, Kowalski indicates the potentiality to apply it to legal inference. Analogy is also a method of inference, and it applies an analogous matter to would like to know to use a well-known matter and it utilizes in legal inference, called legal analogy. Legal analogy is a method to interpret legal sentence, in case there aren't any rules to apply to the case, lawyers are trying to interpret a rule to apply the case.

Based on these consideration, in this study, in order to realize the inference of discovery in legal inference, we have utilized Abductive Logic Programming(ALP) system. ALP is an extension of logic programming to realize abduction, and it is possible to realize according to the extention of SLD resolution. We have utilized the procedure of Kakas and Mancarella in ALP system. Furthermore, in order to realize legal analogy, we have utilized Abstraction-based Analogy. Abstraction-based Analogy is a method that assumes an abstract domain between source domain and target domain, and we utilized Greiner's model in order to realize it. We have integrated these two framework, that is, Abduction and Analogy, and we have realized the inference of discovery. we have utilized Order-sorted Logic for knowledge representation in order to realize Abstraction-based Analogy. Order-sorted Logic is a part of sort logic, and it defines a concept of subsort. We have utilized it by Walther's model. Based on these consideration, in order to realize knowledge abstraction, we utilize the sort hierarchy, and generate the clause hierarchy. In this procedure, in order to realize knowledge abstraction, predicate name and sort attached to clause are abstracted at the same time, as a result, this method realizes abstraction by clause and forms clause hierarchy, and it is the difference between this method and past one. In the former studies of legal analogy, the method to realize abstraction was restricted predicate name or sort attached to clause, these methods restricted the range to realize legal analogy.

In order to evaluate this system, we have carried out two experments, one is the generation of knowledge hierarchy, and we have generated the clause hierarchy using legal sentences and cases by this system, the other is the legal analogy, and we have solved legal problems, namely cases, using clause hierarchy which generated by the generation of knowledge hierarchy. In these experments, as the law to execute the legal inference, we have utilized the United Nation Convention on Contracts for the International Sale of Goods(CISG), Part II and Part III. As the case knowledge, we have utilized several cases, these cases are aimed at experment for legal inference, and these cases are concerned with the conclusion of the contract and the cancellation of the contract, these cases are based on CISG. In order to execute the inference, we have reconstructed these knowledges, they are translated into the expressions of Order-sorted Logic, and legal sentences translated into rules in logic programming, and cases translated into facts. As the result of the generation of knowledge hierarchy, in the lack of knowledge, called hypothesis set in this thesis, that was generated using ALP system, this system could utilize a half of hypothesis set to generate clause hierarchy, we have showed that this system could utilize to generate clause hierarchy. As the result of the legal analogy, this system could reason a part of hypothesis set by analogy, we have showed that this system could realize for legal analogy.

In this studies, we have provided a framework to integrate abduction and analogy, and we could have utilized clause hierarchy which was generated to realize legal analogy. However, we have thought that there are some problems to be proved in the future. In this studies, the algorithms to generate clause hierarchy aren't complete, and there are many parts to depend on user's decision to use this system. We have to examine these problems as our future work. Furthermore, we have found in this studies that the knowledges which needs for inference are beyond the range of legal knowledge. Based on this discovery, we have to examine the method for knowledge representation and inference in order to realize

knowledge acquisition again.