

Title	ALPに基づく仮説選択機構の国際統一売買法への適用に関する研究
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The Application of a Hypothesis Selection Mechanism using ALP to Legal Reasoning

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In this thesis, we deal with a fundamental study of the application of a hypothesis selection mechanism based on Abductive Logic Programming (ALP) to legal reasoning. The target law in this work is the United Nations Convention on Contracts for the International Sale of Goods (CISG). ALP is an extension of logic programming to support abduction in the inference process. Abduction has been recognized as an important form of reasoning with incomplete information, which is essential for solving many problems in artificial intelligence. It is also known as reasoning from effects to causes or explanations. In general, ALP can generate consistent hypotheses for the knowledge with integrity constraints. The framework of ALP is a natural extension of hypothesis-based reasoning. Its applications are fault diagnosis, knowledge assimilation, and so on. Kowalski has suggested the possibility of applying ALP to legal reasoning systems. Recently, legal reasoning, a typical example of normative reasoning, has attracted much attention in the field of artificial intelligence. Legal reasoning systems are applications, whose development, like that of theorem provers, dates back to before artificial intelligence was proposed. In fact, law is closely related to not only the judicial world, but also to all social activities. The more complicated and information-intensive the world becomes, the more complicated and enormous the quantity of legal information becomes. To support legal interpretation and reasoning in a wide range of situations, various legal expert systems have been developed, in addition to reference systems of ordinances, precedents, and so on. In the development of legal expert systems, it became a major task to construct a legal knowledge base, and an inference system consisting of a legal inference, a legal knowledge acquisition support, and a user interface. We focus on a legal discovery mechanism which is closely related to legal inference and legal knowledge acquisition support.

The purpose of this study is to explore the principle of a legal discovery mechanism, which is a main problem accompanying the application of legal knowledge under incompleteness. In the past, researches of knowledge acquisition from legal texts (by Yoshino) have made clear that an inference process which makes up the loss, contributes to legal reasoning in the understanding process of a lawyer. In addition to this, Kunifuji has done research on the application of abduction to a legal discovery mechanism under incompleteness. This research indicates the possible use of abduction in solving some exercises settled by lawyers. Moreover, Kanai proposes algorithms where ALP can manage multiple hypotheses at the same time, by making use of a hypothesis selection mechanism. But it remains an important question, how to meet the demands to calculate a fitness of the hypothesis by a certain standard of legal inference, because it is difficult for the framework of ALP to select the fit hypothesis from among multiple candidates. In real situations, it is frequent for hypothesis-based reasoning to deal with multiple candidate explanations, and very important to select a plausible one from among them.

We propose a hypothesis selection mechanism based on ALP which is able not only to manage multiple hypotheses at the same time, but also to select the most plausible explanation among them. To handle legal knowledge, such a mechanism needs to have a logical standard of a fitness depending on legal domain. To meet this demand, we make good use of a precedent database, including facts and judicial judgments of past cases. We designed a framework of hypothesis selection where some precedents are concerned with the hypothesis in the database, and calculate a fitness which takes account of these precedents. The following indicates the procedure simply.

1. To begin with, ALP enumerates hypothesis sets without fit explanations from the legal knowledge. These generated hypotheses depend on judgments in the precedent database.
2. The system extracts some precedents related with these hypotheses from the database. There are two types of precedents extracted, one supporting the hypothesis, the other not supporting it.
3. The system calculates the fitness of these as to take account of both poles of precedents, based on the premise knowledge. At this step, the total fitness of the hypothesis set is obtained.
4. According to these estimates, ALP selects the fit hypothesis set from among the candidates.

Based on this approach, we made a prototype system for CISG using SICStus-Prolog. We made an experiment to investigate the performance of the system using some questions given by lawyers. We used questions regarding a withdrawal of offer and a conditional acceptance. The evaluation compares these calculations of the fitness between two cases: One is the case where such facts are added as to influence the legal judgment in the knowledge, and the other is the case where no facts are added. We confirmed that this system can select the fit hypothesis set in response to the tendency of the database, by

paying attention to the relative change of the relation value and that of the fitness with the hypothesis. The relation value means a kind of similarity between facts of the premise knowledge and facts of the precedents. As the result, we show that the system could select the fit hypothesis set, in the case where facts were given which influenced the legal judgment in the premise.

In this paper, we proposed a hypothesis selection mechanism based on the study of Kanai, which is not only able to manage multiple hypotheses at the same time, but also to select the fit explanation from multiple candidates. To begin with, we proposed an approach to make good use of the precedent database, including facts and judicial judgments of past cases, and to calculate the fitness of a hypothesis, giving consideration to both types of precedents. In addition to this, we made a prototype system and applied it to CISG based on this approach; some experiments were made by using questions supplied by lawyers. As the result, we indicated the possibility of using our hypothesis selection mechanism. As our future work, we plan to study a method to express knowledge based on legal ontology effectively, and to improve a similarity between facts in the premise knowledge and that in precedents. Moreover, we will implement the expansion of such functions as user interface, and so on. From the point of the calculate mechanism, it is essential to make a better standard so as to calculate a fitness of hypothesis selection, comparing it to case-based reasoning, fuzzy reasoning, and so on. In addition to this, it remains to introduce various types of legal interpretation into the system, and to reflect these interpretations in the demonstration process.