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Author(s)	木村, 祐介
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Description	Supervisor:島津明, 情報科学研究科, 修士

Translation of Legal Sentences including Itemization or Reference into Logical Forms

Yusuke Kimura (0610030)

School of Information Science,
Japan Advanced Institute of Science and Technology

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Legal documents describe structures and functions of our society and regarded as specifications of information systems, which are used everywhere in the present e-society. Accordingly, we can verify propriety of those information systems by verification of logical consistency of legal documents.

For that purpose, a research field called *Legal Engineering* was proposed in The 21st Century COE Program, Verifiable and Evolvable e-Society [Katayama 2005, 2007]. Legal Engineering serves computer aided examination and verification whether a law is established appropriately according to its purpose, there are no logical contradictions or no problems as a document per se, the law is consistent with related laws, and it is modified, added, and deleted consistently for its revision.

In the past years, legal expert systems that serve reasoning with law sentences have been developed. However, these systems require logical forms which are manually translated from law sentences written in natural languages.

Therefore, we are researching methods for automatically converting legal documents into logical forms, and developing the system [Ejiri et al. 2006, Kitada et al. 2006, Nobuoka et al. 2007].

Ejiri proposed a method to analyze law sentences and determine logical structures. it was based on the typical structure of Japanese law sentences, requisition and effectuation structure [Tanaka et al. 1993]. Tanaka indicated that a Japanese law sentence consists of a *subject*, a *condition*, an *object*, a *detail* and a *provision* part, although some sentences lack some of these parts actually. Therefore, Ejiri proposed the converting rules considering this phenomenon, and inspected the accuracy comparing system output with manually converted logical forms.

Kitada compiled a case frame dictionary to determine deep cases, semantic relations between predicate verbs and nouns. He also developed a system to convert subexpressions, which is segmented with Ejiri's system, into atomic logical sentences. The system determines deep cases with the case frame dictionary, also considering properties of Japanese law sentences, then it generates atomic sentences.

Nobuoka progressed the analysis with some more law documents and extended kinds of noun phrases and case structures which the system can analyze. He also constructed case frame dictionary semi-automatically with local regulations among 13 prefectures and proposed a method to determine deep cases based on similarity between a case element and a case frame slot, then adding a score put on slots respectively. Additionally he proposed how to manage a noun phrase “A no B,” according to part-of-speech of A and B, and reimplemented the system to treat recursive analysis of case structures and noun phrases.

However, their system is supposed to analyze a law sentence having one law requisite part and one law effectuation part, there are many sentences having multiple requisite parts or effectuation parts with itemization or reference in law documents actually.

Accordingly, in this paper we propose a method to convert law sentences including itemized parts or referring phrases into logic forms properly.

We took an approach that remove these structures which the previous system cannot process before converting into logic forms. We targeted on National Pension Law and analyzed how these structures appear, then we considered a method to remove them.

To remove references, we directed our attention to a phrase “X ni kitei-suru Y (Y which is enacted in X),” where X acts as a pointer to another law sentence, and Y is a noun. We get the sentence which X indicates, analyze its dependency structure and search for the word Y in the sentence, then we determine that supplements for the word Y are elements which modifying Y in the dependency tree. At last, we replace the phrase “X ni kitei-suru” with the supplements for the word Y.

To remove itemization, we defined phrases that always appear with itemization, like “tsugi-no kaku gou no izureka ni gaitou-suru (which any following items are applicable to)” as a Key Phrase, and we search itemization with it. If a Key Phrase is found, we regard following items as conditions and replace the Key Phrase with one of the conditions respectively. Then we have sentences which are understandable separately, as many as conditions we found.

We implemented both methods and experimented. As regards the reference phrase “X ni kitei-suru Y,” we could derive some sort of information from about 40% of reference phrases in National Pension Law. In cases we could not derive any information, in some cases there’s no information to derive in referred sentences. Other cases, we analyzed their problems. We think our approach to derive supplements from a dependency tree has potential to progress, so we could devise a method to derive information from a tree.

About the experiment with itemization, our system found most of itemization structures in National Pension Law and could process well around 70% of them. We also inspected the system with Income Tax Law as an open test. A little more than half were processed well, there seems to be some difference in notation between National Pension Law and Income Tax Law. We could improve the result by analyzing frequent mistakes.