Transformation Method of Legal Sentences into Logical Forms

Shunsuke Nobuoka (510076)

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

February 8, 2007

Keywords: law sentences, logical form, case analysis, noun phrase analysis.

We are engaged in the research of Legal Engineering in order to achieve a trustworthy electronic society. Legal Engineering serves for examining and verifying whether a law is made appropriately according to its purpose, there are no logical contradictions or no problems as a document, it is consistent with related laws, and it is altered, added, deleted consistently for the revision. It also serves for designing an information system which works for a law. As research of Legal Engineering, we are conducting the research for translating legal sentences into logical representation.

Among researches which treat legal sentences, Tanaka reported that a legal sentence can be divided into a condition part and an effect part. Yoshino proposed an original logical representation for legal sentences. Okada also proposed another representation. For translating legal sentences into logical forms, Ejiri and Kitada implemented a system which analyzes a legal sentence and translates it into first-order logic representation with modal operators. This thesis describes a system which extends their system.

Ejiri and Kitada system parses a sentence, divides it into a condition and en effect part, applies case analysis to the divided subparts, translates the case analysis results into atomic formulas, and integrates them into a logical form of the sentence. However, there are many insufficient parts in the system including analyses of embedded clauses and noun phrases.

In this research, we linguistically investigate legal sentences such as sentences (100 articles 255 clauses 247 items among 244 articles) of the Income Tax Law, sentences (100 articles among 148 articles) of the National Pension Law in addition to sentences (38 articles 90 clauses) of two prefecture laws which were investigated in the previous study by Ejiri and Kitada. Based on this investigation, we extended kinds of noun phrases and case structures which the system can analyze. Reimplementing the system using Lisp, we realized recursive analysis of case structures and noun phrases. We also apply paraphrase analysis for diversity of legal sentence expressions in the same way as dividing a legal sentence into a condition and effect parts.

For segmentation of a sentence, we made 84 patterns based on the linguistic investigation of legal sentences and use the patterns in the system.

We reimplement case analysis in order to treat ambiguities, which is caused by multiple case frames for a verb. For case analysis, we semi-automatically constructed case frame

dictionary presently consisting 217 kinds of verbs from 818 sentences of 13 prefecture bylaws.

We also extended the system ability of noun phrase analysis. For noun phrases with conjunctions, the system segments a noun phrase at conjunctions. For a noun phrase consisting of a embedded clause and a noun, the system analyzes whether there is a case relation between the noun and the embedded clause. When there is not a case relation and the noun is either "koto," "mono," or "houhou," the relation is regarded as apposition. For a noun phrase, "A no B," when the noun A or the noun B is a sahen-conjugation type, case analysis is applied between A and B. When the noun A and B are not sahen-conjugation type, a specific relation between A and B is analyzed using specific frames provided in dictionary entries of A or B.