A Korean Part-of-Speech Tagging System Using Resolution Rules for Individual Ambiguous Word

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Abstract. In this paper we present a Korean part-of-speech tagging system using resolution rules for individual ambiguous word. Our system resolves lexical ambiguities by common rules, rules for individual ambiguous word, and statistical approach. We built resolution rules for each word which has several distinct morphological analysis results with a view to enhancing tagging accuracy. Statistical approach based on Hidden Markov Model (HMM) is applied for ambiguous words that are not resolved by the rules. The experiment on the test set shows that the part-of-speech tagging system has high accuracy and broad coverage.

Keywords: Part-of-Speech, Tagging, Resolution Rules.

1 Introduction

Morphological analyzer is the basic module for most natural language processing systems such as natural language understanding, information retrieval, and machine translation. Morphological analyzer analyzes all possible combination of morphemes for a given word and generates one or more analysis results for that word. In general about 30% of Korean words have two or more analysis results. Resolving these ambiguities is thus vital to build reliable natural language processing system. Part-of-speech tagging is the module to resolve such morphological ambiguities. Conventional part-of-speech tagging approaches are classified into statistical approach[1], rule-based approach[2], and hybrid approach [3].

Hidden Markov Model (HMM) has been the mainstay of the statistical model for part-of-speech tagging. It selects a sequence of part-of-speech tags with the highest probability from words or morphemes around an ambiguous word. Rule-based approach resolves ambiguities by predefined rules. Its major advantage is high accuracy but unlike statistical approach it has narrow coverage. Therefore pure rule-based approach is scarcely used in resolving morphological ambiguities. Hybrid

approach uses both rules and statistical information with a view to achieving high accuracy and broad coverage. Most Korean part-of-speech tagging systems adopt this approach.

This paper presents a part-of-speech tagging system for Korean. The system uses resolution rules for individual ambiguous words to get high accuracy. Each rule has syntax and semantic information for an ambiguous word and words around it. Our system applies common rules to test set followed by resolution rules and statistical tagging.

2 Building Information for Disambiguation

2.1 Common-Rules

Common-rules are ones for idioms and phrases of common use such as “~할 수 있다 (can)”(*halq swu issa*), “~할 수 없다 (cannot)”(*halq swu epsta*), “~하지 않을 수 없다 (must)”(*haci anh.ul swu epsta*). In the first stage common-rules are applied to resolve ambiguities of words. For example the tags of “수”(swu) in above expressions are determined as an incomplete noun.

2.2 Resolution Rules for Individual Ambiguous Word

In this study, “an ambiguous word” is a word that has two or more distinct morphological analysis results. Ambiguous words was collected and the rules for each ambiguous word was built from a large corpus. 330 ambiguous words which amount to 50% of total ambiguous words were chosen. Morphemes, part-of-speech tags, word senses, positions, and/or other information of each ambiguous word and words around it were encoded into rules to resolve the ambiguous word. Some rules are shown in Fig.1.

			tag	meaning
있는	/!e_ @	있/!pa+는/etm	e_	ending
	/e_+/jx	있/!pa+는/etm	etm	adnominal ending
	@			
이	/e_ @	있/!px+는/etm	pa	adjective
	@/!pa	이/!mm	pv	verb
	@/!nc	이/!mm	mm	indeclinable adj.
있었다	/!e_ @	있/!pa+였/ep+다/ef	ep	prefinal ending
	/e_+/jx @	있/!pa+였/ep+다/ef	ec	conjunctive ending
	/e_ @	있/!px+였/ep+다/ef	np	pronoun
그는	all	그/!np+는/jx	nc	common noun
남아	[열혈]/!nc @	남아/!nc	ef	final ending
	@ [선후]/!nc	남아/!nc	jx	auxiliary particle
	default	남아/!pv+아/ec	@	ambiguous word

Fig. 1. An example of resolution rules for individual ambiguous word

2.3 Statistical Information

Information on tag sequences and a word itself were extracted from the tagged corpus. The unit of 3 words information was also extracted. Table 1 shows an example of statistical information extracted in this manner.

Table 1. Example of statistical information

Information about a word, “ yitnuen ”			Information about tag sequences, “nc+co+ec”		
previous tag sequences	next tag sequences	frequency	previous tag sequences	next tag sequences	frequency
nc+jc	nb+co+ef	20	mm	,	6
nc+jc	nb+co+ef+jx	4	mm	?	1
nc+jc	nb+co+ep+ef	2	mm	EOS	1
nc+jc	nb+jc	17	mm	mag	8
nc+jc	nb+jx	11	mm	nc	1
nc+jc	nc	33	...	...	

3 Experiment

For evaluation, ETRI corpus and Sejong corpus were used for the experiment with sentences. Table 2 shows the information of the test corpus. The rate of ambiguity in the table means the average number of morphological analysis results of ambiguous words. First, we apply common rules to an ambiguous word. Rules for individual ambiguous words are applied subsequently when the ambiguity is not resolved. First matching rule is applied to an ambiguous word when the conditions of two or more rules are satisfied. Statistical information is applied finally when the ambiguity is not resolved. Table 3 shows the result of tagging with the rules only, tagging with only statistical information, and tagging with both.

In Table 3, the average rate of correctness with rules only is 88.68 and resolution accuracy by rules is almost 100%; the average rate of correctness with statistical information is 93.82%. These results are comparable to the best performance of conventional Korean statistical part-of-speech system.

Table 2. The information of corpus for evaluation

Corpus	The total number of words	The number of ambiguous words	The rate of ambiguity
ETRI corpus	12357	4836	2.66
Sejong corpus	4911	1761	2.74
Total	17628	6597	2.70

Table 3 also shows that the average rate of correctness of our system that uses both rules and statistical information is higher than those of systems that use only rules or only statistical information. Furthermore, the accuracy of our system is 96.86% which

is higher than any other conventional hybrid tagging systems whose accuracies varies from 93% to 96%. Our system does not resolve the ambiguities correctly when two or more consecutive words are all ambiguous.

Table 3. The correctness of each tagging

Corpus	Tagging with rules	Tagging with statistical information	Tagging with rules and statistical information
ETRI corpus	89.67%	95.14%	97.74%
Sejong corpus	87.69%	92.50%	95.98%
Total	88.68%	93.82%	96.86%

4 Conclusion

In this paper, we described a hybrid Korean part-of-speech tagging system using rules and statistical information. About 50% of ambiguities are resolved by those rules, and their accuracy is almost 100%. Statistical tagging based on HMM is applied to words which are not resolved by rules. The correctness of our system was 95.98%, while that of statistical tagging only was 93.82%. The system failed to resolve correctly the ambiguities for consecutive ambiguous words.

Acknowledgments. This research was supported by the Ministry of Information and Communication, Korea under the ITRC, IITA-2006-(C1090-0603-0046).

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