Collection of Usage Information for Language Resources from Academic Articles

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Abstract

Recently, language resources (LRs) are becoming indispensable for linguistic researches. However, existing LRs are often not fully utilized because their variety of usage is not well known, indicating that their intrinsic value is not recognized very well either. Regarding this issue, lists of usage information might improve LR searches and lead to their efficient use. In this research, therefore, we collect a list of usage information for each LR from academic articles to promote the efficient utilization of LRs. This paper proposes to construct a text corpus annotated with usage information (UI corpus). In particular, we automatically extract sentences containing LR names from academic articles. Then, the extracted sentences are annotated with usage information by two annotators in a cascaded manner. We show that the UI corpus contributes to efficient LR searches by combining the UI corpus with a metadata database of LRs and comparing the number of LRs retrieved with and without the UI corpus.

1. Introduction

In recent years, such language resources (LRs) as corpora and dictionaries are being widely used for research in the fields of linguistics, natural language processing, and spoken language processing, reflecting the recognition that objectively analyzing linguistic behavior based on actual examples is important. Therefore, since the importance of LRs is widely recognized, they have been constructed as a research infrastructure and have become indispensable for linguistic research. However, existing LRs are not fully utilized. Even though metadata search services for LR archives (Hughes and Kamat, 2005) and web services for LRs (Dalli et al., 2004; Biemann et al., 2004; Quasthoff et al., 2006; Ishida et al., 2008) have become available, it has not been enough for users to efficiently find and use LRs suitable for their own purposes so far.

If there exists a system which could give us a list of LRs that can be answers to the questions such as “Which LRs can be used for developing a syntactic parser?” and “Which LRs can be used for developing a Chinese-English machine translation system?” it would help users efficiently find appropriate LRs.

The information satisfying these demands is sometimes described as usages of individual LRs on their official home pages. The metadata database of LRs named SHACHI (Tohyama et al., 2008) is managing and providing it in an integrated fashion by collecting and listing it as “usage information” for LRs. SHACHI contains metadata on approximately 2,400 LRs. However, the number of lists of usage information registered in SHACHI is only about 900 LRs since the usage information is not usually described on the official home while it is often described in academic articles. For instance, the following sentence found in the proceedings of ACL2006 shows that Roget’s Thesaurus is useful for word sense disambiguation, although usage information is not announced on the web page of Roget’s Thesaurus1.

- He also employed Roget’s Thesaurus in 100 words of window to implement WSD.

Therefore, we could more easily find LRs suitable for our own purposes by collecting lists of usage information for LRs from academic articles and integrating them with metadata contained in SHACHI. Although the method for automatically extracting the lists was proposed (Kozawa et al., 2008), the variation of the extracted usage information was limited since their extraction rules were based on the analysis of small lists of usage information. This issue would be addressed by collecting large lists of usage information and then analyzing them to expand the extraction rules. Therefore, in this paper, we propose to construct a text corpus annotated with usage information (UI corpus). This paper is organized as follows. In sections 2, we introduce the design of UI corpus. Then, we construct the UI corpus by extracting sentences containing LR names from academic articles and annotating them with usage information in section 3. In sections 4 and 5, we provide statistics of the UI corpus and analytical results of usage information contained in the UI corpus. We show that the UI corpus contributes to efficient LR searches by combining the UI corpus with a metadata database of LRs and comparing the number of LRs retrieved with and without the UI corpus in section 6. Finally, in section 7, we describe the summary of this paper and the future work.

2. Design of the UI Corpus

2.1. Data Collection

It is unrealistic to collect all sentences and annotate them because only small number of sentences in an article include usage information for LRs. In this issue, Kozawa et

1http://poets.notredame.ac.jp/roget/about.html
al. reported that most of the instances of usage information for LRs are found in the sentences containing LR names (Kozawa et al., 2008). Therefore, in this research, we collect sentences having LR names from academic articles to build the UI corpus.

2.2. Annotation Policy

The collected sentences are annotated with the following information: (A), (B) and (C) are provided for each sentence. (D) and (E) are provided for word sequences. (A) through (D) are automatically provided when sentences have been collected from academic articles.

(A) sentence ID

(B) the title of the proceeding

(C) LR name

(D) usage information

Each word sequence matched with usage information for a certain LR is annotated with UI tags. Word sequences are annotated with usage information by referring only to a given sentence without adjacent sentences in order to reduce the labor costs of annotators.

In our research, we assume that usage information A for LR X can be paraphrased as “X is used for A.” The followings are examples of usage information for WordNet.

- We use ⟨LR|WordNet⟩/⟨LR⟩ for ⟨UI|lexical lookup⟩/⟨UI⟩.
- ⟨LR|WordNet⟩/⟨LR⟩ ⟨UI|specifies relationships among the meanings of words⟩/⟨UI⟩.
- It uses the content of ⟨LR|WordNet⟩/⟨LR⟩ to ⟨UI|measure the similarity or relatedness between the senses of a target word and its surrounding words⟩/⟨UI⟩.

Note that since usage information indicates specific events, such vague expressions as “our proposed method” and “this purpose” are not our target. We also ignore expressions that can be represented by “X is used for X” and those that represent updating, expansion, or modification of LR X, as shown in the following example:

- We applied an automatic mapping from ⟨LR|WordNet 1.6⟩/⟨LR⟩ to ⟨LR|WordNet 1.7.1⟩/⟨LR⟩ synset labels.

3. Construction of the UI Corpus

This section describes a method for constructing the UI corpus. Figure 1 shows the flow of the corpus construction. First, sentences containing LR names are automatically extracted from academic articles. Then, the extracted sentences are annotated by two annotators in a cascaded manner.

3.1. Automatic Extraction of Sentences Containing LR Names

First, we converted academic articles to plain texts using the Xpdf\(^2\). We used 2,971 articles which are contained in the proceedings of ACL from 2000 to 2006, LREC2004 and LREC2006 because LRs were often used in the field of computational linguistics. Next, we extracted sentences

\(^2\)http://www.foolabs.com/xpdf/
containing the LR names from the articles. As for the LR names, approximately 2,400 LRs registered in SHACHI (Tohyama et al., 2008) were used. Consequently, 10,959 sentences were extracted from 1,848 articles and word sequences matched with the LR names are automatically annotated with the LR tags.

3.2. Annotation of Word Sequences with Usage Information

Two annotators were involved in the annotation. One of the annotators (Annotator 1) had an experience in collecting metadata in SHACHI, while the major of the others (Annotator 2) was computational linguistics. It was difficult for Annotator 1 to annotate usage information if a given sentence contains technical terms in the field of computational linguistics, since Annotator 1 was unfamiliar with computational linguistics. Therefore, Annotator 1 annotated sentences at first, and then Annotator 2 annotated the same sentences to recover the annotation errors produced by Annotator 1.

Examples of corpus annotation are shown in Figure 2. First, the following actions were done by Annotator 1:

- Annotating word sequences representing LR names with the LR tags
- Annotating word sequences representing the usage information for LRs with the UI tags

Next, Annotator 2 judged whether the UI tags provided by Annotator 1 were correct and modified them if they were inappropriate.

For annotation, the annotators used the Web-based GUI as shown in Figure 3. They could make annotation by selecting an appropriate tag from the choice box appeared by clicking the button shown in Figure 3.

3.3. Corpus Size

The size of the annotated corpus is shown in Table 3.2.

In the process of annotation, sentences which did not contain any LR names were removed from the corpus. Therefore, the corpus consists of a set of sentences containing LR
names extracted from academic articles.

4. Statistics of the UI Corpus

This section shows the frequently used LRs and the difference between the LRs tagged with the UI tags in the UI corpus and the LRs whose usage information were registered in SHACHI by comparing the statistics of the UI corpus with that of SHACHI.

We semi-automatically assigned each LR tag with an LR id used in SHACHI and counted the number of LRs appearing in our corpus. Consequently, 882 LRs were found. Then, we investigated the breakdown of the LR tags. We found that the most frequent LR was WordNet. One of the reasons is that WordNet is frequently used as a lexical database. Another reason is that it has been translated into various languages by the initiative of Global WordNet Association.\(^3\)

Out of 882 LRs, 365 were tagged with the UI tags. We investigated whether the usage information for the LRs was registered in SHACHI or not, and found that usage information for 305 LRs was not registered in SHACHI. This shows that usage information for LRs newly extracted from academic articles were almost double of that originally registered in SHACHI. We expect that the more usage information could be extracted if we used more variety of academic articles and it would help users efficiently find and use LRs suitable for their own purposes by registering lists of usage information for finding more LRs than those obtained only with SHACHI.

5. Analysis of Usage Information

This section shows the number of types of usage information and LRs used in various fields.

Lists of usage information were analyzed to know how many types of usage information were collected. Then, we manually classified them into 51 classes (see Table 4.) in the fields of computational linguistics and spoken language processing, which are session names appeared twice or more in the proceedings of ACL from 2000 to 2006 or ICSLP 2000, 2002, 2004 and 2006, by referring to the articles containing target usage information. Note that each usage information is classified into one or more classes.

3http://www.globalwordnet.org/

Classification results are shown in Table 4. Column 2 and 3 represent the number of UI tags classified into each class and the number of articles containing the UI tags, respectively. The number of LRs tagged with the UI tags are shown in column 4. In column 5, frequently used LRs in each fields are represented and parenthetical figure denotes the number of articles using the LRs. Large lists of usage information in the fields of “lexical semantics” and “word sense disambiguation” were collected since WordNet was frequently used. Out of 51 classes, 39 have one or more UI tags. This shows that the UI corpus contains various usage information.

We investigated the number of classes to which UI tags were classified for each LR to find LRs used in various fields. Results of the investigation are shown in Table 5. We found that Penn Treebank is the most widely used LR. In addition, British National Corpus is also widely used although the frequency of British National Corpus is lower than those of WordNet and Penn Treebank.
6. Contribution of the UI Corpus

We compared the number of LRs retrieved with and without usage information in the UI corpus. In the experiments, we used keywords as queries and got a list of LRs whose usage information registered in SHACHI or in the UI corpus. As queries for the LR search, we used 40 keywords in the “Topics of Interest” appearing in the paper submission page of ACL2008.

The experimental results are shown in Table 6. The number of LRs retrieved using usage information in both SHACHI and the UI corpus increased for 15 keywords. This indicates that lists of usage information in the UI corpus contribute to efficient LR searches.

We are planning to train the model for extracting usage information for LRs by using our corpus to improve the performance of automatic usage information extraction and extract usage information from various articles. Then, we expect that more various LRs can be found.

7. Conclusion

In this paper, we described how to construct the UI corpus to efficiently find and use appropriate LRs. First, we automatically extracted sentences containing LR names from academic articles. Then, two annotators tagged the extracted sentences with usage information. We showed that the UI corpus contributes to efficient LR searches by combining the UI corpus with a metadata database of LRs.

In the near future, we will provide an LR search service to promote the efficient use of LRs by integrating usage information with a metadata database of LRs called SHACHI (Tohyama et al., 2008).

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| class | # of UI tags | # of articles | # of LRs | frequently used LR |
|-------|-------------|---------------|-----------|-------------------|
| Lexical Semantics | 188 | 110 | 35 | WordNet(82), UMLS(54), EuroWordNet(4) |
| Word Sense Disambiguation | 182 | 88 | 32 | WordNet(61), Semcor(88), Roger's(50), Longman Dictionary(5) |
| Semantics | 147 | 81 | 38 | WordNet(52), FrameNet(10), PropBank(17) |
| Corpora | 130 | 66 | 51 | WordNet(28), Penn Treebank(4), VerbNet(4), British National Corpus(4) |
| Information Extraction | 104 | 71 | 43 | WordNet(22), British National Corpus(6), ACR(5), GENIA(4) |
| Parsing | 66 | 44 | 30 | Penn Treebank(22), CCGBank(13) |
| Tagging | 59 | 40 | 29 | Penn Treebank(11), GENIA(4), CGN(4) |
| Question Answering | 48 | 26 | 13 | WordNet(15), IREX(3), Wikipedia(2), Extended WordNet(2) |
| Machine Translation | 32 | 16 | 11 | WordNet(5), Czech Treebank(2), British National Corpus(2) |
| Asian Language Processing | 36 | 30 | 24 | MNCM(11), Simca Treebank(2), EDR(2) |
| Grammars | 30 | 22 | 8 | Penn Treebank(17), British National Corpus(2) |
| Information Retrieval | 29 | 22 | 12 | WordNet(9), TREC(14), NTIER(2), EuroWordNet(2) |
| Coreference | 25 | 13 | 15 | WordNet(4), British National Corpus(2), Reuters corpus(2), ACR(2) |
| Named Entity Recognition | 25 | 19 | 18 | MUC(4), GENIA(3), UMLS(2), WordNet(2), Reuters corpus(2) |
| Statistical Parsing | 25 | 15 | 7 | Penn Treebank(10), CCGBank(2) |
| Syntax | 18 | 15 | 10 | Penn Treebank(9) |
| Spoken Language Processing | 17 | 11 | 12 | Spoken Dutch Corpus(2), Penn Treebank(2) |
| Dialogue | 17 | 11 | 9 | ICSI Meeting corpus(2), British National Corpus(2) |
| Chunking | 16 | 9 | 8 | Penn Treebank(5) |
| Summarization | 14 | 11 | 10 | MNCM(5), English Broadcast News corpus(2) |
| Generation | 14 | 9 | 9 | WordNet(2) |
| Text Categorization | 12 | 12 | 10 | Reuters-21578 corpus(3), WordNet(2), Gigaword corpus(2) |
| Morphology | 11 | 9 | 8 | Arabic Treebank(3), Chinese Penn Treebank(2) |
| Robust ASR | 10 | 8 | 9 | SpeechStat(1), LC-Start(1), ATIS corpus(1) |
| Language Modeling | 10 | 9 | 8 | British National Corpus(3), Yomiuri Newspapers(1) |
| Language Acquisition | 9 | 7 | 5 | WordNet(3) |
| Statistical Machine Translation | 9 | 6 | 8 | WordNet(2) |
| Pronouns | 9 | 6 | 8 | Spoken Dutch Corpus(1), TDT(1), TTS evaluation corpus(1) |
| Segmentation | 9 | 4 | 8 | British National Corpus(1), Penn Treebank(1), ICSI corpus(2) |
| Phonetics | 8 | 6 | 5 | Spoken Dutch Corpus(2), CELEX(2) |
| Linguistics | 8 | 5 | 5 | WordNet(2) |
| Discourse | 6 | 5 | 3 | CELEX(2), Penn Treebank(2) |
| Large Vocabulary Speech Recognition | 4 | 3 | 3 | British National Corpus(2) |
| Speech Recognition | 4 | 3 | 3 | SpeechStat(1), Slovenian broadcast news speech database(1) |
| Applications | 3 | 3 | 3 | WordNet(1), Brown Corpus(1), MNCM Daily News(1) |
| Speech Processing | 3 | 2 | 2 | NIST(1), RT corpus(1) |
| Speech Synthesis | 2 | 2 | 2 | LC-Start(1), MTEU Turkish Corpus(1) |
| Acoustic Modeling | 2 | 1 | 1 | NIST corpus(1) |
| Speech Analysis | 1 | 1 | 1 | Czech National Corpus(1) |
Table 6: Results of verification experiment using the UI corpus.

| Keywords                        | SHACHI | SHACHI+UI corpus |
|--------------------------------|--------|------------------|
| dialogue                       | 8      | 12               |
| embodied conversational agents  | 0      | 0                |
| language-enhanced platforms     | 0      | 0                |
| information retrieval          | 52     | 54               |
| text data mining                | 0      | 0                |
| information extraction         | 11     | 11               |
| filtering                      | 0      | 2                |
| recommendation                 | 0      | 0                |
| question answering              | 0      | 3                |
| topic classification           | 0      | 0                |
| text classification            | 3      | 3                |
| sentiment analysis             | 0      | 0                |
| attribute analysis             | 0      | 0                |
| genre analysis                 | 0      | 0                |
| language generation            | 1      | 1                |
| summarization                  | 8      | 14               |
| machine translation            | 55     | 57               |
| language identification        | 21     | 21               |
| multimodal processing          | 0      | 0                |
| speech recognition             | 211    | 228              |
| speech generation              | 3      | 1                |
| speech synthesis               | 32     | 34               |
| phonology                      | 0      | 0                |
| POS tagging                    | 1      | 7                |
| syntax                         | 0      | 7                |
| parsing                        | 11     | 19               |
| grammar induction              | 0      | 0                |
| mathematical linguistics       | 0      | 0                |
| formal grammar                 | 0      | 0                |
| semantics                      | 1      | 5                |
| textual entailment             | 0      | 0                |
| paraphrasing                   | 0      | 2                |
| word sense disambiguation      | 0      | 11               |
| discourse                      | 10     | 14               |
| pragmatics                     | 0      | 0                |
| statistical and machine learning| 0     | 0                |
| language modeling              | 25     | 25               |
| lexical acquisition            | 0      | 0                |
| knowledge acquisition          | 0      | 0                |
| development of language resources| 0     | 0                |

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