Development of a Japanese-English Software Manual Parallel Corpus

Tatsuya Ishisaka†
Kazuhide Yamamoto†
† Nagaoka University of Technology
1603-1 Kamitomiokamachi, Nagaoka,
Niigata 940-2188, Japan
{ishisaka,ykaz}@nlp.nagaokaut.ac.jp

Masao Utiyama††
Eiichiro Sumita††
†† MASTAR Project
National Institute of Information
and Communications Technology
3-5, Hikaridai, Seika, Soraku,
Kyoto 619-0289, Japan
{mutiyama,eiichiro.sumita}@nict.go.jp

Abstract

To address the shortage of Japanese-English parallel corpora, we developed a parallel corpus by collecting open source software manuals from the Web. The constructed corpus contains approximately 500 thousand sentence pairs that were aligned automatically by an existing method. We also conducted statistical machine translation (SMT) experiments with the corpus and confirmed that the corpus is useful for SMT.

1 Introduction

Multilingual parallel corpora are required to support many tasks in natural language processing. For example, statistical machine translation (SMT) requires a parallel corpus for training, and cross-lingual processing such as information retrieval and information extraction also use parallel corpora. There is no doubt on the importance of parallel corpora for any language pair.

Specially, Japanese-English parallel corpora are very scarce. Although some parallel corpora (Utiyama and Isahara, 2007) are available, the domains and sizes of these corpora are limited.

In general, European countries use multiple languages officially. Based on this multilingual environment, Koehn (2005) has built a corpus by collecting parallel texts in eleven languages from the proceedings of the European Parliament, which are published on the Web.

However, some countries such as Japan have no such language situation, that leads us difficulties for creating parallel corpora. Hence, more efforts are needed to collect them effectively.

Available Japanese-English parallel corpora are scarce. However, there are a lot of translated texts on the Web. Specially, open source manuals are translated into Japanese from English by volunteer translators.

We collected such English and Japanese texts. Then, the sentences in collected texts were automatically aligned, resulting in a parallel corpus made from open source software manuals. Manuals of open source software has been used for making a parallel corpus named OPUS (Tiedemann and Nygaard 2004), which was made from OpenOffice.org documentation\footnote{http://www.openoffice.org}, KDE manuals including KDE messages\footnote{http://i18n.kde.org}, and PHP manuals \footnote{http://www.php.net/download-docs.php}. However, the Japanese-English part of OPUS is not large. In contrast, we collected about 500 thousand sentence pairs. In addition, our work involved extensive human efforts to ensure the quality of our parallel corpus.

The translation quality of open source software manuals are considered to be relatively high, because they are translated by many translators who belong to the projects and drafts of the translations are corrected by other project members. Therefore,
we can trust the quality of software manuals.

In the following we present how we collect, clean, and align software manuals. We also illustrate performance of SMT experiments using the corpus.

2 Target license

We will publish a parallel corpus constructed from open source software manuals. This action is considered as a redistribution with modifications. We therefore target licenses that allow redistribution and modifications.

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3 Characteristics of manuals

The software manuals are difficult to handle with. Japanese open source software manuals usually contain both Japanese and English texts. Consequently, some parts of manuals are not needed for making parallel corpora. For example, when manuals explain commands, the commands are not translated into Japanese. Further, open source software manuals often include program source codes, which are not translated.

4http://www.opensource.org/licenses/mit-license.php
5http://www.freebsd.org/copyright/freebsd-doc-license.html
6http://creativecommons.org/licenses/by-nc-sa/3.0/deed.en
7http://opensource.org/licenses/cddl1.php
8http://wiki.netbeans.org/FaqCDDLinANutshell
Software is periodically updated, primarily by adding new features and functionality. Thus, new sentences are typically added to the corresponding manuals. As a result, the latest original document version may be newer than the translated document version. Therefore, we have to collect original and translated documents with matching versions. This needs human efforts.

In many cases, translated open source software manuals are HTML files with HTML tags that conform to the original document’s format, but this need not be so. Therefore, we have to modify translated documents to match the original format. In addition, the formats of open source manuals differ from project to project. Consequently, we have to write a script to extract text portions for each project.

4 Constructing the corpus

Constructing the Japanese-English corpus takes three steps;

(1) searching for open source software manuals on the Web
(2) cleaning up documents, and
(3) aligning sentences.

We describe these three steps in the following subsections.

4.1 Searching for open source software manuals

We used Web search engines manually to search for open source software manuals. We searched for Japanese Web pages containing phrases such as 翻訳プロジェクト (translation project). Then, we manually checked if those pages contained software manuals. If they had, we downloaded manuals. We also searched for the corresponding manuals in English. When downloading documents, we checked and matched the versions of both English and Japanese documents.

Table 1 show list of collected manuals and their URLs. In the table, JF represents “Linux Japanese FAQ Project.” JF translates documents related with Linux. JM means “JM project.” JM translates Linux manual pages. RFC represents “Request for Comments.” Note that RFCs are not manuals, but their contents are similar to manuals and their use and importance are widespread. Others are open source software manuals.

4.2 Cleaning up documents

Software manuals contain HTML tags. We normalize documents by deleting HTML tags with a Perl script using pattern matching. This script is tailored to each software manual.

Sentences in software manuals are often broken by newlines. It is difficult to judge whether a newline character represents a sentence end or not. For example, headings are usually separated by newlines without periods. We delete newline characters in a paragraph, which is defined by a text region separated by empty lines, if that paragraph contains punctuation. Otherwise, newlines are not deleted because they are regarded as sentence ends.

4.3 Aligning sentences

We use Utiyama and Isahara’s alignment method, because their method has been successfully used in aligning noisy Japanese-English parallel texts (Utiyama and Isahara, 2007). Below is a concise description of their algorithm.

We begin by obtaining the maximum similarity sentence alignments. Let $J$ and $E$ be a Japanese text file and an English text file, respectively. We calculate the maximum similarity sentence alignments $(J_1, E_1)$, $(J_2, E_2)$, $\ldots$, $(J_m, E_m)$, using a dynamic programming matching method (Gale and Church, 1993), where $(J_i, E_i)$ is a Japanese and English sentence alignment pair in $J$ and $E$. We allow 1-to-$n$, $n$-to-1 ($0 \leq n \leq 5$), or 2-to-2 alignments when aligning sentences. The similarity between $J_i$ and $E_i$ is calculated based on word overlap (i.e., number of word pairs from $J_i$ and $E_i$ that are translations of each other based on a bilingual dictionary with 450,000+ entries). The similarity between a Japanese document, $J$, and an English document, $E$, (noted $AVSIM(J, E)$) is calculated using:

$$AVSIM(J, E) = \frac{\sum_{i=1}^{m} SIM(J_i, E_i)}{m}$$  \hspace{1cm} (1)

A high $AVSIM(J, E)$ value occurs when the sentence alignments in $J$ and $E$ take on high similarity values. We also calculate the ratio of the number of
sentences between \( J \) and \( E \) (noted \( R(J,E) \)) using:

\[
R(J, E) = \min \left( \frac{|J|}{|E|}, \frac{|E|}{|J|} \right)
\]  

(2)

where \(|J|\) is the number of sentences in \( J \), and \(|E|\) is the number of sentences in \( E \).

A high \( R(J,E) \) value occurs when \(|J| \sim |E|\). Consequently, \( R(J,E) \) can be used to measure the proportion of potentially corresponding sentences. Using \( AVSIM(J,E) \) and \( R(J,E) \), we defined the similarity between \( J \) and \( E \) (noted \( AR(J,E) \)) as

\[
AR(J,E) = AVSIM(J,E) \times R(J,E)
\]  

(3)

Finally, we define the score of alignment \( J_i \) and \( E_i \) as

\[
Score(J_i, E_i) = SIM(J_i, E_i) \times AR(J,E)
\]  

(4)

A high \( Score(J_i, E_i) \) value occurs in the following case: (1) sentences \( J_i \) and \( E_i \) are similar, (2) documents \( J \) and \( E \) are similar, and (3) the number of sentences \(|J|\) and \(|E|\) are similar. \( Score(J_i, E_i) \) combines both sentence and document similarities to discriminate between correct and incorrect alignments.

4.4 Results of sentence alignment

We examined the results of the sentence alignment and concluded that 1-to-1, 1-to-2, or 2-to-1 sentence alignments are clean. Thus, we extracted only these sentence alignments to make our parallel corpus. Although we included all 1-to-1, 1-to-2, or 2-to-1 alignments, it is possible to extract only highly precise sentence alignments if we use the score defined in Equation 4, as verified in (Utiyama and Isahara, 2007).

Table 2 shows the number of aligned sentences. Overall, there are a total of just under 500 thousand sentences. Among these, over 90% of sentence alignments are 1-to-1.

Table 3 shows examples of aligned sentences. As the examples show, some Japanese sentences include English words, such as “PUT” or “root”. We also see that both long and short sentences are included.

We found that over 80% of sentence alignments were precisely aligned. We think that further improvements are possible, since we have failed to clean up some noisy sentences. Our simple pattern match rules did not work well for removing some sentences such as notes by translators. We expect that the alignment accuracy would improve if we remove such noisy sentences.

5 MT Experiments

MT experiments were conducted to verify the usefulness of our constructed corpus for SMT. We used the Moses system (Koehn et al., 2007). We used GIZA++ (Och and Ney, 2003) for word alignment and SRILM (Stolcke, 2002) for language modeling. In our experiments, we used 5-gram language models. Minimum error rate training (MERT) was per-
Table 2: Number of aligned sentences

| English | Japanese |
|---------|----------|
| sentences | tokens(average of sentences) | tokens(average of sentences) |
| FreeBSD  | 10528 | 156749(14.9) | 245780(23.34) |
| Gentoo Linux | 11117 | 1488461(13.39) | 224324(20.17) |
| JF | 122072 | 1867792(15.30) | 2854297(23.38) |
| JM | 41573 | 483098(11.62) | 731045(17.58) |
| Net Beans | 32774 | 450849(13.76) | 682299(20.82) |
| PEAR | 23333 | 294233(12.61) | 446863(19.15) |
| PHP | 67023 | 639857(13.76) | 682299(20.82) |
| PostgreSQL | 22843 | 396570(17.36) | 627994(27.49) |
| Python | 26215 | 297830(11.36) | 499860(19.07) |
| RFC | 128827 | 2229786(17.31) | 3201737(24.85) |
| XFree86 | 12155 | 171725(14.27) | 277254(22.81) |
| total | 498460 | 8476950(13.77) | 10768664(21.20) |

Table 3: Example of parallel sentences

| Japanese | English |
|----------|---------|
| 現在設定されている PUT ファイルへのパスを含む文字列を返します。 | Returns a string containing the path to the currently set put file. |
| これらはそれぞれ通常ユーザと root のデフォルトパスです。 | That will be a default path for normal and root users respectively. |
| クライアント機は Grub で、フロッピーディスクからブートします。 | The client machine boots from a Grub floppy disk. |
| メッセージの HTTP ヘッダを含む連想配列を返します。 | Returns an associative array containing the messages HTTP headers. |
| 画像のマットチャネルを設定します。 | Sets the image matte channel. |
| さまざまなハッシュアルゴリズムを使用して、任意の長さのメッセージに対する直接的あるいは段階的な処理を可能とします。 | Allows direct or incremental processing of arbitrary length messages using a variety of hashing algorithms. |
| 塗りつぶしや描画を行わず現在のパスオブジェクトを終了します。 | Ends current path object without performing filling and painting operations. |
| これはユーザが所有する BIOS 設定、カーネル構成、およびいくつかの簡素化を含んでいます。 | This includes BIOS settings, kernel configuration and some simplifications in user land. |
| このシグナルはリモートからセッションのチェックポイントを行うときに利用できる。 | This signal can be used to perform a remote checkpoint of a session. |
| Xlib はテキストの描画やテキストのデザインの計算で必要な時だけフォントをロードし、フォントデータをキャッシュすることを選択できる。 | Xlib may choose to cache font data, loading it only as needed to draw text or compute text dimensions. |

formed to tune the decoder’s parameters on the basis of the bilingual evaluation understudy (BLEU) score (Papinei et al., 2002). The evaluation was done using a single reference. Tuning was performed using the standard technique developed by Och (Och, 2003). The test and development data were extracted from the aligned JF sentences. Each of test and development data consists of 500 sentences.
In the following experiments, we simulated a situation where an SMT system was applied to help volunteer translators translate English JF documents into Japanese. We want to use all parallel sentences efficiently to help translators. This is a problem of domain adaptation. All of parallell sentences were translated from English to Japanese. Therefore we did MT experiments from English.

In the first experiment, we used all parallel sentences (excluding development and test sentences) as our training data, which contained approximately 500 thousand parallel sentences, as shown in Table 2. The BLEU score obtained was 37.38.

In the second experiment, we used only JF parallel sentences (approximately 100 thousand sentences). The BLEU score obtained was 40.02.

In the third experiment, we linearly interpolated language models of the first and second experiments. We changed the weight of JF’s language model from 0.1, 0.3, 0.5, 0.7, and 0.9. The BLEU scores were 38.40, 39.30, 38.92, 40.07, and 42.53. The BLEU score was highest when the weight is 0.9. The translation model used was that in the first experiment.

In the fourth experiment, we log-linearly interpolated translation models of the first and second experiments. The weights were set with MERT. The BLEU score was 41.26. The language model used was that in the first experiment.

In the final experiment, we used the language model with a weight of 0.9 in the third experiment and the translation model in the fourth experiment. The BLEU score was 44.36, which was the highest in these experiments.

6 Discussion

The BLEU scores obtained were relatively high for a Japanese-English corpus. For example, Utiyama and Isahara (2007) reported a maximum BLEU score of 25.89 for patent document SMT.

However, we have to be careful about our experimental results. First, our test sentences were extracted from those having the highest alignment scores, which might not be representative samples. This was because sentences with low alignment scores could be wrong alignments, which were not suitable for measuring SMT performance. We plan to sample test sentences from the whole corpus and clean them for the purpose of evaluation in our future work. Second, our Japanese word segmenter segmented ASCII words into characters. (Japanese words were segmented properly.) For example, “word” was segmented into “w o r d” in the corpus used in the above experiments. Consequently, the BLEU scores obtained were optimistic, though the occurrences of ASCII words were much smaller than those of Japanese words.

Because the BLEU scores were rather optimistic, we manually examined test sentences. We found that short sentences were generally translated well and longer sentences were not translated well.

Overall, we concluded that our parallel corpus is useful for English-Japanese SMT developments. We also hope that this corpus will be useful for supporting human translations of these manuals.

7 Conclusion

We have reported a project on developing a Japanese-English parallel corpus made from software manuals. It has approximately 500 thousand sentence pairs. The corpus will be available at http://www2.nict.go.jp/x/x161/members/mutiyyama/manual/index.html

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