Evaluating Machine Translation Performance on Chinese Idioms with a Blacklist Method

Yutong Shao\textsuperscript{1}, Rico Sennrich\textsuperscript{2}, Bonnie Webber\textsuperscript{2}, Federico Fancellu\textsuperscript{2}

\textsuperscript{1}School of Electronic Engineering and Computer Science, Peking University
5 Yiheyuan Road, Haidian District, Beijing, China
sythello@pku.edu.cn

\textsuperscript{2}School of Informatics, University of Edinburgh
10 Crichton Street, Edinburgh, United Kingdom.
rico.sennrich@ed.ac.uk, bonnie@inf.ed.ac.uk, s1260346@sms.ed.ac.uk

Abstract
Idiom translation is a challenging problem in machine translation because the meaning of idioms is non-compositional, and a literal translation is likely to be wrong. In this paper, we assess the quality of idiom translation of a modern neural MT system. We introduce a new evaluation method based on an idiom-specific blacklist of literal translations, based on the insight that the occurrence of any blacklisted words in the translation output indicates a likely translation error. We introduce a dataset, CIBB (Chinese Idioms Blacklists Bank), and perform an evaluation of a state-of-the-art Chinese-English neural MT system. Our evaluation confirms that our blacklist method is effective at identifying literal translation errors, and that a sizable number of idioms in our test set are mistranslated (36.5%).

Keywords: Chinese-English machine translation, evaluation, idiom translation, blacklist method, CIBB dataset

1. Introduction

Idioms are a special figure of speech that are non-compositional and non-literal, though occasionally share surface realizations with literal language uses (Salton et al., 2014). Idioms are considered highly problematic for a wide variety of NLP tasks (Sag et al., 2002). This belief also holds true for machine translation, because MT systems often make the assumption that each word in the sentence are independent, which is not true for idioms. This wrong assumption often lead the MT system to make literal translations errors, namely it translates an idiom word-by-word, getting a translation that is confusing and not understandable. Therefore, idioms translation is a tough problem in MT and has attracted many researchers to work on (Cap et al., 2015; Salton et al., 2014; Anastasios, 2010).

Our research is aimed at helping with measuring an MT system’s performance on idiom translation, so as to facilitate further researches on idiom translation. By now, there are already many methods for evaluation the performance of MT systems, but none of them are satisfactory for our purpose. The most straightforward method is human evaluation, however human translation is too slow, costly and also prone to biases (Isabelle et al., 2017). Popular automatic MT metrics such as BLEU (Papineni et al., 2002) are inexpensive, but are unsuitable for a targeted evaluation. (Sennrich, 2017) propose an evaluation via contrastive translation pairs, where a reference translation is paired with a contrastive translation which introduces a single translation error, allowing to measure the sensitivity of a neural MT (NMT) system towards this type of error. However, this method only measures the probability of pre-defined translations, and is less suitable if the type errors that a system may make are relatively unpredictable.

In this paper, we introduce a new method called “blacklist method” for performance evaluation on idioms, which is based on the intuition that a literal translation of the components of the idiom is likely to be wrong, and easy to spot by defining a blacklist of literal translations for each idiom that indicate a likely translation error.

We perform a case study on a special class of Chinese idioms that typically consist of 4 characters, called “cheng2 yu3”. Actually, not all the “cheng2 yu3” satisfy the definition of idioms - some are compositional and can be translated literally, so these are less problematic and less necessary to look at. In this research we will only focus on those 4-character words with different literal meanings and idiomatic meanings. We will subsequently refer to them as “Chinese idioms”.

We also introduce the CIBB dataset[1] for actually executing this evaluation on Chinese-English MT systems. Based on this dataset, we confirm that idiom translation remains an open problem in Chinese→English NMT.

2. Blacklist Method

The “blacklist” method we are going to describe is used for detecting literal translation errors. Literal translation errors are an important type of error in machine translation, because they occur often according to our preliminary observations, and sometimes they can be very harmful (Arffman, 2012). We hypothesize that literal translation errors represent a majority of idiom translation errors.

The idea of blacklist method is that, for a certain idiom, some words representing the meanings of single characters but not the whole idiom may appear in the literal translation, but they should not appear in the idiomatic translation. This kind of words make up the “blacklist” for the idiom, which means they should not be in the translation. If we do see any word on the blacklist appears in the translation, we say that the translation is an incorrect literal translation. For the example in Table[1] if you give an MT system a Chinese sentence with this idiom and

\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
Idiom & Translation \\
\hline
"cheng2 yu3" & "literal translation" \\
\hline
\end{tabular}
\caption{Example of blacklist method}
\end{table}

\footnotesize{\textsuperscript{1}This dataset is released at https://github.com/sythello/CIBB-dataset}
the system outputs a translation containing “bamboo” or “chest”, then we say the translation trigger the blacklist and therefore will be judged as a literal translation error.

| Idiom                  | 胸有成竹                  |
|------------------------|---------------------------|
| Idiometic translation  | Be very ready; have a     |
| (correct)              | well-thought-out plan     |
| Literal translation    | Have a well-formed bamboo in one’s chest |
| (incorrect)            |                           |
| Blacklist              | bamboo, chest             |

Table 1: Example of blacklist.

Using the concept of blacklist, here we give the whole process of “blacklist method” evaluation:

1. Build an idiom list with idioms that are easy to build blacklist for.
2. Build a blacklist for each idiom on the list.
3. Gather translation pairs containing idioms on the list. If the reference translations are not needed, monolingual datas are also usable.
4. Translate all the sentences containing idioms.
5. Calculate the percentage of translations triggering the blacklist.

We draw on an existing idiom list for step 1 and perform step 2 manually.

2.1. The Advantages and Disadvantages of Blacklist Method

The main advantage of the blacklist method is that, after creating the blacklist, large-scale evaluation is inexpensive and reproducible. The selection of proper idioms and the construction of a blacklist for each idiom is feasible by a bilingual speaker, and future work may even try to automate this. After the idiom list and blacklists are determined, we can scale up the set of translation pairs as much as we need, using online bilingual or even monolingual datasets. We expect the blacklist method to achieve a high precision, because the definition of “blacklist” is actually closely related to literal translation errors.

The drawback of this method is that the method is restricted to only one error type, literal translation errors, and will not detect any other type of errors such as deletions or repetitions of the idiom. Hence, recall is uncertain.

3. Dataset Construction

In CIBB, we provide a list of 50 Chinese idioms, each paired with an idiom-specific blacklist, and 1194 Chinese-English translation pairs, each containing an idiom on the list.

3.1. Idioms and Blacklists

We downloaded about 30000 Chinese idioms from the websites listed in Table 2. After excluding all the idioms that never appeared in the training data of our NMT system, there are about 9000 idioms left. Among these 9000 idioms, we observed some samples of them and picked out 50 commonly used idioms with different frequencies in the training data. According to our observation, idioms with very high frequency in the training data are generally translated well, so we focus on lower-frequency idioms. Meanwhile, we cannot expect a system to learn to translate idioms with too low frequency. Therefore, the 50 idioms on the idiom list are chosen to be in a certain frequency range, from 7 to 1000 occurrences in the training data. We further select only idioms whose translation is non-compositional, and create a blacklist for each idiom.

3.2. Translation Pairs

The translation pairs were derived from OpenSubtitles2016 dataset [Lison and Tiedermann, 2016], where we searched for Chinese-English translation pairs with idioms on our list. In order to balance the frequency of all the idioms in the translation pairs, preventing the majority being taken up by only a few idioms, we restricted the maximum occurrences of any idiom to be 40. Under such restrictions, we picked up a total of 1194 translation pairs.

4. Experiments

The objective of our experiments is to evaluate the effectiveness of the blacklist method at detecting translation errors, especially the literal translation errors, by its precision, recall, as well as the correlation with BLEU score method which is the most widely used evaluation method for MT by now. Also, we want to test to what extent idiom translation is a problem for a current state-of-the-art NMT system.

4.1. The MT System

As a representative of the current state of the art in NMT, we evaluate the Edinburgh NMT system for the WMT17 shared news translation task [Sennrich et al., 2017], which was ranked tied best for Chinese→English. The system is an attentional encoder-decoder, and its training data is constrained to the training data provided at WMT17, namely News Commentary v12, UN Parallel Corpus V1.0, the CWMT Corpus, and back-translated monolingual data from the News Crawl Corpus. On the Chinese side, the system uses Jieba[^1] for word segmentation, and BPE for subword segmentation [Sennrich et al., 2016]. More details about the model architecture can be found in the system description.

[^1]: https://github.com/fxsjy/jieba
4.1. Word Segmentation
Unlike in English where words are delimited by whitespaces, Chinese text does not contain any whitespace for word segmentation. Therefore word segmentation is needed when processing Chinese sentences. Our MT system performs both word segmentation and subword segmentation, and it is worth noting that different approaches of word segmentation may lead to different results in our test. The test method focuses on literal translation errors, which can only happen if an idiom is segmented into several parts, not if the idiom is unsegmented and treated as a single unit. Treating the idiom as a single unit may be an effective approach to prevent literal translation errors, but may increase vocabulary size and/or cause other types of errors that are not captured by the blacklist. Evaluating the effect of (sub)word segmentation on idiom translation remains the subject of future work.

4.2. Test Results
We translated all the 1194 Chinese source sentences into English. Among all the 1194 translations, 145 were found to have triggered the blacklist, taking up a proportion of 11.9%. Our first question is how effective the blacklist method is at identifying literal translation errors, both in terms of precision and recall, and we performed a manual evaluation to test this. For the 145 translations triggering the blacklist, we checked all of them to see whether they are really literal translation errors; for the 1049 translations not triggering the blacklist, we randomly sampled 100 translations from them and calculated the percentage of correct, incorrect and incorrect literal translations, so as to estimate these figures for all the 1049 translations.

The results of our test on our system are shown in Table 3. Here we provide some examples for different types of translations we discussed in section 4.2.

4.4. Examples
Here we provide some examples for different types of translations.

4.4.1. Correctly Detected Errors

| Idiom | Meaning |
|-------|---------|
| 说三道四 | Gossip |
| three four | |

| Idiom | Meaning |
|-------|---------|
| 失败 | Failure |
| 失败者 | Loser |

| Idiom | Meaning |
|-------|---------|
| 医生说了你不能对我说三道四 | The therapist said you’re not allowed to judge me. |
| 不能 | Can’t |

Table 5: Example for correctly detected errors.

In the example shown in Table 5 the word “three” may appear in an incorrect literal translation but should not appear in the correct idiomatic translation. Therefore, the “three” in the output implies that the system is making an literal translation error, which is successfully caught by the blacklist.

4.4.2. False Positives

In this example shown in Table 6 the idiom is actually translated correctly into “talk and laugh”. However, there is a “wind” in another place of the source sentence, and that triggered the blacklist. This example shows why the blacklist method does not reach 100% precision. Future
work could involve further constraints, such as taking into account alignment information, to further reduce false positives.

4.4.3. Not Detected Errors

| Idiom     | 生龙活虎 |
|-----------|---------|
| Meaning   | Full of energy |
| Blacklist | dragon tiger |
| SRC       | 你明明生龙活虎到处走 |
| REF       | You were so actively walking around just then |
| TRANS     | You have to go all over the place |

Table 7: Example for not detected errors.

In this example shown in Table 7 the idiom meaning “full of energy” or “actively” is incorrectly translated into “have to”. However, as this is not a literal translation error, our blacklist method is unable to catch it. This is a limitation of the blacklist method, which is only designed to capture literal translation errors.

5. Conclusion

We introduced the blacklist method for evaluating the performance of MT systems on idioms. This method works by automatically detecting literal translation errors and calculating the error rate. The results of our experiments have shown that the blacklist method is useful for detecting this kind of errors. The experiments also confirm that idiom translation remains an open problem for NMT systems. We introduced the dataset CIBB which is used for executing blacklist method evaluation on Chinese-English MT systems. The dataset contains 50 semantically non-transparent idioms and 1194 Chinese-English translation pairs.

6. Acknowledgements

This research is supported by the Summer Research Visitor Programme between the School of Electronic Engineering and Computer Science at Peking University and the Institute for Language, Cognition and Computation in the School of Informatics at the University of Edinburgh.

7. Bibliographical References

Anastasiou, D. (2010). Idiom Treatment Experiments in Machine Translation. Cambridge Scholars Publishing.

Arffman, I. (2012). Unwanted literal translation: An underdiscussed problem in international achievement studies. 2012, 08.

Cap, F., Nirmal, M., Weller, M., and Schulte im Walde, S. (2015). How to account for idiomatic support verb constructions in statistical machine translation. In MWE@NAACL-HLT, pages 19–28. The Association for Computer Linguistics.

Isabelle, P., Cherry, C., and Foster, G. (2017). A challenge set approach to evaluating machine translation. In Proceedings of the 2017 Conference on Empirical Methods in Natural Language Processing, pages 2476–2486. Association for Computational Linguistics.

Lison, P. and Tiedemann, J. (2016). Opensubtitles2016: Extracting large parallel corpora from movie and TV subtitles. In LREC. European Language Resources Association (ELRA).

Papineni, K., Roukos, S., Ward, T., and Zhu, W. (2002). Bleu: a method for automatic evaluation of machine translation. In ACL, pages 311–318. ACL.

Sag, I. A., Baldwin, T., Bond, F., Copestake, A. A., and Flickinger, D. (2002). Multiword expressions: A pain in the neck for NLP. In CICLing, volume 2276 of Lecture Notes in Computer Science, pages 1–15. Springer.

Salton, G., Ross, R. J., and Kelleher, J. D. (2014). Evaluation of a substitution method for idiom transformation in statistical machine translation. In MWE@EACL, pages 38–42. The Association for Computer Linguistics.

Sennrich, R., Haddow, B., and Birch, A. (2016). Neural Machine Translation of Rare Words with Subword Units. In Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers), pages 1715–1725, Berlin, Germany, August. Association for Computational Linguistics.

Sennrich, R., Birch, A., Currey, A., Germann, U., Haddow, B., Heafield, K., Barone, A. V. M., and Williams, P. (2017). The university of edinburgh’s neural MT systems for WMT17. In WMT, pages 389–399. Association for Computational Linguistics.

Sennrich, R. (2017). How grammatical is character-level neural machine translation? assessing MT quality with contrastive translation pairs. In EACL (2), pages 376–382. Association for Computational Linguistics.