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POST-EDITING FOR THE KAZAKH LANGUAGE

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Abstract. The modern world and our immediate future depend on applied intelligent systems, as new technologies develop every day. One of the tasks of intelligent systems is machine (automated) translation from one natural language to another. Machine translation (MT) allows people to communicate regardless of language differences, as it removes the language barrier and opens up new languages for communication. Machine translation is a new technology, a special step in human development. This type of translation can help when you need to quickly understand what your interlocutor wrote or said in a letter.

The work of online translators used to translate into Kazakh and vice versa. Translation errors are identified, general advantages and disadvantages of online machine translation systems in Kazakh are given. A model for the development of a post-editing machine translation system for the Kazakh language is presented.

OpenNMT (Open Neural Machine Translation) is an open source system for neural machine translation and neural sequence training. To learn languages in OpenNMT, you need parallel corpuses for language pairs. The advantage of OpenNMT is that it can be applied to all languages and can handle large corpora. Experimental data were obtained for the English-Kazakh language pair. Experimental data were obtained for the English-Kazakh language pair.

Applied intelligent systems play an important role in the modern world. One of their tasks is machine translation (MT) from one language into another one. MT allows people to freely communicate despite language barriers. This new technology is a special step in helping to understand what a companion speaks, or writes to you. Automatic post-editing is the task of correcting errors present in texts as a result of machine translation. Since MT cannot always give the desired result, it becomes necessary to edit the translation. The drawbacks of the translation have to be eliminated by post- editing. This need for post-editing is largely determined by the quality of machine translation: low-quality translation leaves a lot of room for post-editing, and high-quality and human translations require minimal text editing. This work describes the development of the light post-editing module for the English-Kazakh language pairs. The neural network model is trained on pairs mt, pe and triplets src, mt, pe using the OpenNMT framework. Then the results of the BLEU metrics mt - pe and mt - ape are compared, and a conclusion about the quality of post-editing is made.

Key words: Opennmt, neural machine translation, bleu, automatic post-editing, network model

Introduction

Post-editing is one of the first and superficial stages in the ma chine translation (MT) post-editing system. The light post-editing module includes getting the raw MT output and making as few changes to the text as possible to make the translation clear, accurate in facts, and grammatically correct [1]. The light post-editing module includes the following post-editing tasks:

- correction of only the most obvious typos, vocabulary, and grammatical errors
- correction of machine errors
- removal of unnecessary or redundant translation options created by the machine
- agreement on the key terminology, but without careful check ing of terms

When translating from any language into Kazakh, we use different online translators. Very

popular online translators: Yandex, Google.

But even in these online translators there are errors. Basically, errors are obtained when translating complex sentences.

Also when translating phraseological units. In the online translator, phraseological units are translated to as if. Also, some terms are changed, even if this was not taken into account.

The Kazakh language is a complex language in structure. Therefore, after receiving the translation, human editing is required. This is called automatic post-editing.

There are three kinds of automatic post-editing. Such as full post-editing, medium post-editing, light post-editing. All of these edits are included in automatic post-editing. After the model is created, the translation is automatically edited. Created prior to this model, not all the requirement fulfills the post-editing of the Kazakh language.

Therefore, post-editing of the Kazakh language requires the creation of a model. The article created a transformer model. Also created post-editing model for the Kazakh language can be used for other Turkic languages.

Because these languages are similar in vocabulary and also in the structure of languages. In the following table, you can see the similarity of Turkic words.

Table 1. Turkic words

ol	ol	ʻol	ul	ол jol/	ol	oʻl	ol	рук чол)
emiz	emiz	emiz	imez	емиз semiz/	emiz	emiz	emiz	емис
ncient urkic	urkish	urkmen	urkmen	nKazakh	ygyz	nuzbek	nUyghur	yvan

na	na/anne	ne	na	на/ана/	ne	na	na	ва
urun	urun	urun	orın	murın/	urun	urun	urun	умчук
ol	ol	ol	ul	л qol/	ol	o‘l	ol	ол

But languages are different from other languages, they have special characteristics: proximity of the lexical structure;

- the law of harmony;
- agglutination – a series of affixes;
- lack of a category;
- lack of auxiliary words (prepositions);
- special word order;

Therefore, when translating, the Turkic languages give out morphological, lexical, and semantic errors. This article discusses training parallel corpus in Opennmt. The advantage of Opennmt is its universal applicability to different languages, including the Turkic languages. We also get the results of computational experiments for the Kazakh language. The rest of the paper is organised as follows:

- Section 2 provides an overview of previous work carried out in this area.
- Section 3 presents Opennmt for Kazakh-English, English-Kazakh language pairs.
- Section 4 presents experimental NMT results for Kazakh-English, English-Kazakh language pairs.
- Section 5 presents conclusions and suggests directions for future work.

Previous scientific work

In our country, in Kazakhstan, MT (machine translation) of the Kazakh language has been developing since 2000. Professor U. A. Tukeyev was one of the first to study machine translation. He managed to create a scientific school that is actively engaged in research in the field of MT. Among domestic students, one can note the study of models and methods of semantics of machine translation from Russian into Kazakh language [2], a statistical model of the alignment of English-Kazakh words using the machine translation algorithm [3].

To improve the morphologies of the Turkic languages, vocabulary training on a parallel corpus was used [4-6]. Learning on the parallel corpus of the English-German language pair in Opennmt, studied in foreign works. In this work, 50k vocabulary was learned for each pair and it was shown that in Opennmt Bleu was 17.60 [7]. Opennmt showed a better result than in the Nematus Bleu system by 0.5. Also, the architecture and applicability of Opennmt in other areas were considered.

Automatic post-editing (APE) is an area of research aimed at studying methods that apply editing operations to MT output to obtain better translations. APE covers a wide range of post-editing approaches, from regular expressions applied to MT.

APE systems convert mt, a text received by MT, into mt', a corrected version of the translation in the same language. The APE task can be thought of as a monolingual translation task in which the source and target languages are the same. Thus, APE implementations are very similar to MT systems and even use similar methodologies. However, in the MT scenario, the system learns pairs of sentences src, pe, where src is the texts in the source language, pe is the high-quality texts in the target language. In the APE script, training Such data allows you to successfully train the system to identify both simple spelling and syntax errors, and the consistency of words in the original sentences. The learning process depends on the availability of a sufficient amount of data and high-quality texts in the target pe language.

Algorithm for post-editing

An algorithm is used to post-edit a translation from a machine translation. The algorithm is performed as follows: neuron machine translation from the target language x1: s to the desired language w1:T $p(w_{1:T}|x) = \prod_1^T p(w_t|w_{1:t-1}, x; \theta)$ translates with distribution. Post-editing model w1, w2, .., wt-1 translates source vector words into hidden vector words h1,… hs. The target decoder in the model combines the source words with the vector and the corresponding hidden words, and assumes the probability of the next processed words to appear [8,9]. The maximum probability p (w_t | w_ (1: t-1), x; θ) is then used to obtain a sequence of processed words. A hidden word sequence is needed to link the original word sequence to be translated and the sequence of words to be translated. To maximize the probability of the model, it is necessary to read and study the whole sequence of sentences in the case. Figure 2 shows the training of neuron machine translation model in OpenNMT.

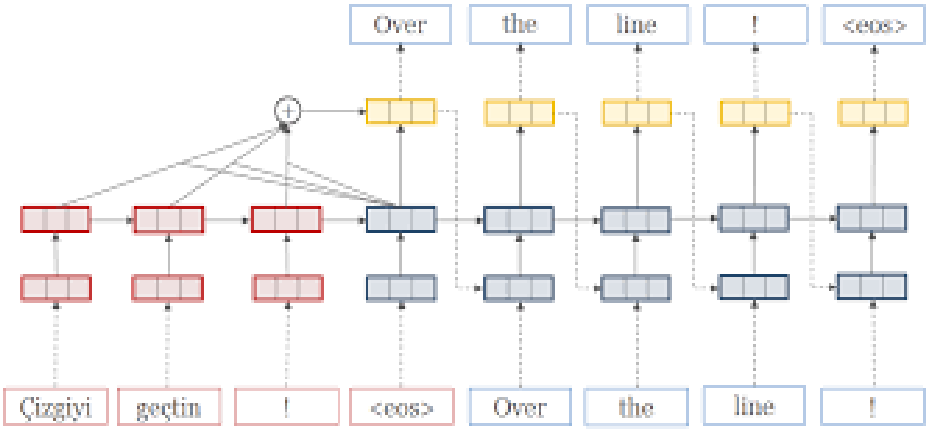

Figure – 1. OpenNMT for learning neuron machine translation model

OpenNMT is an open source generated by neurons. OpenNMT can be downloaded from GitHub (https://github.com/OpenNMT/OpenNMT). Thanks to OpenNMT, data does not take up much memory, machine translation training takes less time. Implementation of training consists of three stages [10]:

1) Data preparation. It consists of words, phrases and sentences in Kazakh and English, created in parallel in two files.

Data preparation is performed using the code onmt_build_vocab -config toy_en_de.yaml -n_sample 10000. The location of the file must be specified. Type in the YAML configuration file:

data:

corpus_1:

```
    path_src: toy-ende/src-train.txt
    path_tgt: toy-ende/tgt-train.txt
  valid:
    path_src: toy-ende/src-val.txt
    path_tgt: toy-ende/tgt-val.txt
```

YAML configuration file Add the following information:

```
Модельді оқыту:
src_vocab: toy-ende/run/example.vocab.src
tgt_vocab: toy-ende/run/example.vocab.tgt
# Train on a single GPU
world_size: 1
gpu_ranks: [0]
# Where to save the checkpoints
save_model: toy-ende/run/model
save_checkpoint_steps: 500
train_steps: 1000
valid_steps: 500
```

In this model we prepare a learning step and a neural model. Then we run this model onmt_train -config toy_en_de.yaml.

3) Translation

In translation, it translates 1000 words or sentences from a pre-rendered file. To translate it, write onmt_translate -model toy-ende / run / model_step_1000.pt -src toy-ende / src-test.txt -output toy-ende / pred_1000.txt -gpu 0 –verbose code.

To create a dictionary for further study, it is necessary to process (tokenize) the data collected in a parallel cas

```
d a t a :
s a v e _ d a t a : OpenNMT / MT_corpus /
en g_ kaz / p r e p r o c e s s e d _ d a t a / m t_kaz/
s r c _ v o c a b : OpenNMT / MT_corpus / en g_ kaz /
p r e p r o c e s s e d _ d a t a / m t_kaz . v ocab . s r c
t g t _ v o c a b : OpenNMT / MT_corpus / en g_ kaz /
p r e p r o c e s s e d _ d a t a / m t_kaz . v ocab . t g t
t r a i n :
p a t h _ s r c : OpenNMT / MT_corpus / APE_da ta /
E n g_ k a z_ d a t a / e n g_ k a z_45000 / m t _ k a z _ t r a i n . t x t
p a t h _ t g t : OpenNMT / MT_corpus / APE_da ta /
E n g_ k a z_ d a t a / e n g_ k a z_45000 / p e _ k a z _ t r a i n . t x t
v a l i d :
p a t h _ s r c : OpenNMT / MT_corpus / APE_da ta /
E n g_ k a z_ d a t a / e n g_ k a z_45000 / m t _ k a z _ v a l i d . t x t
p a t h _ t g t : OpenNMT / MT_corpus / APE_da ta /
E n g_ k a z_ d a t a / e n g_ k a z_45000 / m t _ k a z _ v a l i d . t x t

# S avi n g  c h e c k p o i n t
s a v e _ c h e c k p o i n t _ s t e p s : 2000
```

To obtain a quality result, the t r a n s f o r m e r model was used to train the parallel corps.

50,000 steps were used to teach 45,000 parallel sentences in the case. Commonly used settings can be seen in the following code:

```
# V a l i d a t i o n  s t e p s
v a l i d _ s t e p s : 2000
# T r a i n i n g  s t e p s
t r a i n _ s t e p s : 50000
# O p t i m i z a t i o n
```

```
optim : adam
l e a r n i n g _ r a t e : 2 . 0
# Model
d e c o d e r _ t y p e : t r a n s f o r m e r
 e n c o d e r _ t y p e : t r a n s f o r m e r
```

The experiment was performed on a computer with the following characteristics: CPU - Core i7 4790, 32 GB of RAM, 1 TB SSD and GPU-RTX 2070 Super.

Results

A Kazakh-English language pair was used for training. 109,772 sentences were used in the corpus. These proposals were taken from the website : Akorda, Primeminister, mfa.gov.kz, economy.gov.kz, strategy2050.kz. Of these, it was taken for train 80000, test 20000, validation 9772.It took 36 hours to train at Opennmt.

OpenNMT is a deep learning framework specializing in the Sequence-to-sequence model and covering a wide range of tasks related to machine translation, speech recognition, image- to-text conversion, and more. Corpus training for post-editing is implemented using it. This experiment explores post-editing for an English-Kazakh language pair. Obtained from open sources and using the Bitextor application, 45,000 English-Kazakh parallel sentences were used in this experiment. The parallel corpus for the English-Kazakh language pair was collected from various official sites, and the corpora were aligned and tokenized. The translation As you can see in the table BLEU is less compared to other languages as for English- German, English-French pairs. Because the structure of the language of the Turkic languages is different from these languages. More parallel data is required to improve this metric.

Table 2. The result

Language pair	BLEU(MT)	BLEU(APE)
Kazakh-English	18.45	20.56
English-Kazakh	16.55	20.05

The original src English corpus has been implemented by such machine translation systems as Prompt, Yandex, and Webtran. To train the post-editing model mt - pe , the data was divided into training 80%, validation 10% and test 10%.

The analysis of the results of improving MT was carried out using the bilingual evaluation understudy (BLEU metric). BLEU is an algorithm for evaluating the quality of text translated from one natural language to another. Quality is interpreted as the correspondence between the results of the work of a machine and a person.

Conclusion

Additional experiments showed that OpenNMT improved the quality of translation by creating a model of neural machine translation and processing the Kazakh translation from Google, Yandex online translation. In the article, the model read and processed more than 100 thousand parallel sentences, which showed a much higher rate than after the machine translation. In the article, the Kazakh language was chosen as one of the Turkic-speaking languages as an experiment. As a result of the experiment on the Kazakh-English language pair, after processing, the BLEU value was 20.56. The value of the translation from the unprocessed direct machine translation was 15.70.

Reading the data takes less time and saves memory. As a result of experimental research, it can be seen that the Kazakh-English and English-Kazakh language pairs gave good results in translation. For further research, this model is to obtain translations from other Turkic-speaking languages. For this purpose, a corpus will be assembled for other Turkic-speaking languages.

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ҚАЗАҚ ТІЛІНЕ АРНАЛҒАН ПОСТ-РЕДАКТОРЛЕУ

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Аңдатпа. Қазіргі әлем және біздің жақын болашағымыз қолданбалы интеллектуалды жүйелерге байланысты, өйткені күн сайын жаңа технологиялар дамып келеді. Интеллектуалды жүйелердің міндеттерінің бірі – бір табиғи тілден екінші табиғи тілге машиналық (автоматтандырылған) аудару. Машиналық аударма (МТ) адамдарға тілдік айырмашылықтарға

қарамастан сөйлесуге мүмкіндік береді, өйткені ол тілдік кедергіні жояды және қарым-қатынас үшін жаңа тілдерді ашады. Машиналық аударма – бұл жаңа технология, адам дамуындағы ерекше қадам. Аударманың бұл түрі екі түрлі тілде сөйлесетін адамдардың хатта не жазғанын немесе айтқанын тез түсінуге көмектеседі. Интернеттегі онлайн аудармашылардың мақсаты қазақ тіліне және керісінше аудару. Мақалада аударма қателері анықталды, қазақ тіліндегі онлайн машиналық аударма жүйелерінің жалпы артықшылықтары мен кемшіліктері келтірілді. Қазақ тіліне арналған өңдеуден кейінгі машиналық аударма жүйесін әзірлеу үлгісі ұсынылған.

OpenNMT (Open Neural Machine Translation) – нейромашиналық аудармаға және нейрондық тізбекті оқытуға арналған ашық бастапқы жүйе. OpenNMT тілінде тілдерді үйрену үшін тіл жұптары жинақталған параллель корпустар қажет. OpenNMT артықшылығы - оны барлық тілдерге қолдануға болады және үлкен корпустарды өңдей алады. Ағылшын-қазақ тілі жұбы бойынша эксперименттік деректер алынды. Қолданбалы интеллектуалды жүйелер қазіргі заманғы маңызды рөл атқарады. Олардың міндеттерінің бірі - бір тілден екінші тілге машиналық аударма (МТ) қолдану. МТ адамдарға тілдік кедергілерге қарамастан еркін сөйлесуге мүмкіндік береді. Бұл жаңа технология серіктестің сізге не сөйлейтінін немесе жазғанын түсінуге көмектесетін ерекше қадам болып табылады. Автоматты өңдеуден кейінгі өңдеу – машиналық аударма нәтижесінде мәтіндердегі қателерді түзету міндеті. МТ әрқашан қажетті нәтижені бере алмайтындықтан, аударманы өңдеу қажет болады. Аударманың кемшіліктерін кейінгі өңдеу арқылы жою керек. Пост-редакторлеу бұл қажеттілігі негізінен машиналық аударманың сапасымен анықталады: төмен сапалы аударма кейінгі өңдеуге көп орын қалдырады, ал жоғары сапалы және адамдық аудармалар мәтінді ең аз өңдеуді қажет етеді. Бұл жұмыс ағылшын-қазақ тіліндегі жұптарға арналған жеңіл өңдеуден кейінгі модульдің дамуын сипаттайды. Нейрондық желі моделі OpenNMT құрылымы арқылы mt, pe және triplets src, mt, pe жұптарында оқытылады. Содан кейін mt - pe және mt - ape BLEU метрикасының нәтижелері салыстырылады және кейінгі өңдеу сапасы туралы қорытынды жасалады.

Түйін сөздер: Opennmt, нейромашиналық аударма, bleu, автоматты кейінгі өңдеу, желілік модель.

ПОСТРЕДАКТИРОВАНИЕ ДЛЯ КАЗАХСКОГО ЯЗЫКА

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Аннотация. Современный мир и наше ближайшее будущее зависят от прикладных интеллектуальных систем, так как новые технологии развиваются каждый день. Одной из задач интеллектуальных систем является машинный (автоматизированный) перевод с одного естественного языка на другой. Машинный перевод (МП) позволяет людям общаться вне зависимости от языковых различий, так как снимает языковой барьер и открывает новые языки для общения. Машинный перевод — это новая технология, особая ступень в развитии человечества. Этот вид перевода может помочь, когда вам нужно быстро понять, что ваш собеседник написал или сказал в письме.

Работа онлайн-переводчиков используется для перевода на казахский язык и наоборот. Выявляются ошибки перевода, приводятся общие преимущества и недостатки онлайн-систем машинного перевода на казахский язык. Представлена модель разработки системы постредактирования машинного перевода для казахского языка.

OpenNMT (Open Neural Machine Translation) — это система с открытым исходным кодом для нейронного машинного перевода и обучения нейронных последовательностей. Для изучения языков в OpenNMT нужны параллельные корпуса для языковых пар. Преимущество OpenNMT в том, что его можно применять ко всем языкам и обрабатывать большие корпуса. Экспериментальные данные были получены для англо-казахской языковой пары. Прикладные интеллектуальные системы играют важную роль в современном мире. Одной из их задач является машинного перевода (МП) перевод с одного языка на другой. МТ позволяет людям свободно

общаться, несмотря на языковые барьеры. Эта новая технология — особый шаг, помогающий понять, что собеседник говорит или пишет вам. Автоматическое постредактирование — это задача исправления ошибок, возникших в текстах в результате машинного перевода. Так как МП не всегда может дать желаемый результат, возникает необходимость редактирования перевода. Недостатки перевода приходится устранять постредактированием. Эта потребность в постредактировании во многом определяется качеством машинного перевода: некачественный перевод оставляет много места для постредактирования, а качественный и человеческий перевод требует минимального редактирования текста. В данной работе описывается разработка легкого модуля постредактирования для англо-казахских языковых пар. Модель нейронной сети обучается на парах mt, pe и триплетах src, mt, pe с использованием фреймворка OpenNMT. Затем сравниваются результаты метрик BLEU mt - pe и mt - ape и делается вывод о качестве постредактирования.

Ключевые слова: Opennmt, нейронный машинный перевод, bleu, автоматическое постредактирование, сетевая модель.

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