論文内容の要旨

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Neural machine translation (NMT) has achieved sufficient translation quality in the general domain, but not yet in the out-of-domain. Therefore, post-editing (PE), which manually corrects mistranslations, is still crucial, especially in fields where errors are not allowed, e.g., the medical domain. This dissertation tackles these essential problems of machine translation ranging from translation to post-editing using interpretable models.
We firstly prevent the degradation of the translation quality in the out-of-domain. In previous work, kNN (k-nearest neighbor) was employed in NMT models and applied to various domains using the example-based approach; however, the example search is time-consuming and the decoding speed becomes two orders of magnitude slower than that of standard NMT. To improve the decoding speed of kNN-MT, we propose subset kNN-MT, which reduces the search space to the neighboring examples of the input sentence and employs an efficient computation method using the distance lookup table. Subset kNN-MT achieved a speed-up of up to 134.2 times and an improvement in BLEU score of up to 1.6 compared with kNN-MT in the De-En domain adaptation task.
The other problem is to efficiently check and correct translation errors that still occur despite improvements in translation quality even by subset kNN-MT. We then aim to improve the efficiency of human PE. Prior automatic PE (APE) models attempt to correct the outputs of an MT model; however, many APE models are based on sequence generation, and thus their decisions are harder to interpret for human post-editors. We propose an edit-based PE model, which breaks the editing process into two steps, “error detection” and “error correction.” The detector model tags each MT output token whether it should be corrected and/or reordered while the corrector model generates corrected words for the spans identified as errors. Experiments on the WMT’20 En-De and En-Zh APE tasks showed that our detector-corrector improved translation edit rate (TER) compared to not only an edit-based model but also a black-box sequence-to-sequence model by 0.7 points in En-De and En-Zh. Moreover, our model is more explainable than sequence-to-sequence models because it is based on edit operations.

論文審査結果の要旨

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Neural machine translation (NMT) has achieved sufficient translation quality in the general domain, but not yet in the out-of-domain. Therefore, post-editing (PE), which manually corrects mistranslations, is still crucial, especially in fields where errors are not allowed, e.g., the medical domain. This dissertation tackles these essential problems of machine translation in terms of text generation and post-editing using interpretable models.
The first work prevents the degradation of the translation quality in the out-of-domain. In prior work, kNN (k-nearest neighbor) was employed in NMT models and applied to various domains using the example-based approach; however, the example search is time-consuming and the decoding speed becomes two orders of magnitude slower than that of standard NMT. To improve the decoding speed of kNN-MT, subset kNN-MT reduces the search space to the neighboring examples of the input sentence and employs an efficient computation method using the distance lookup table. The second work aims to improve the efficiency of human PE. Prior automatic PE (APE) models attempt to correct the outputs of an MT model; however, many APE models are based on sequence generation, and thus their decisions are harder to interpret for human post-editors. The new edit-based PE model breaks the editing process into two steps, “error detection” and “error correction.” The detector model tags each MT output token whether it should be corrected and/or reordered while the corrector model generates corrected words for the spans identified as errors.
The two studies are published as one high quality peer-reviewed journal paper and two peer-reviewed international conference papers. The research would have an impact not only to the natural language processing, in particular, to the diverse area of machine translation, but to the relevant fields of machine learning, e.g., text generation and interpretable modeling. As a result, the thesis is sufficiently qualified as a Doctoral thesis of Engineering.