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Learning to Translate by Learning to Communicate to an Entailment Classifier

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Abstract : We present a reinforcement-learning-based method of training neural machine translation models without parallel corpora. The standard encoder-decoder approach to machine translation suffers from two problems we aim to address. First, it needs parallel corpora, which are scarce, especially for low-resource languages. Second, it lacks psychological plausibility of learning procedure: learning a foreign language is about learning to communicate useful information, not merely learning to transduce from one language's 'encoding' to another. We instead pose the problem of learning to translate as learning a policy in a communication game between two agents: the translator and the classifier. The classifier is trained beforehand on a natural language inference task (determining the entailment relation between a premise and a hypothesis) in the target language. The translator produces a sequence of actions that correspond to generating translations of both the hypothesis and premise, which are then passed to the classifier. The translator is rewarded for classifier's performance on determining entailment between sentences translated by the translator to disciple's native language. Translator's performance thus reflects its ability to communicate useful information to the classifier. In effect, we train a machine translation model without the need for parallel corpora altogether. While similar reinforcement learning formulations for zero-shot translation were proposed before, there is a number of improvements we introduce. While prior research aimed at grounding the translation task in the physical world by evaluating agents on an image captioning task, we found that using a linguistic task is more sample-efficient. Natural language inference (also known as recognizing textual entailment) captures semantic properties of sentence pairs that are poorly correlated with semantic similarity, thus enforcing basic understanding of the role played by compositionality. It has been shown that models trained recognizing textual entailment produce high-quality general-purpose sentence embeddings transferrable to other tasks. We use stanford natural language inference (SNLI) dataset as well as its analogous datasets for French (XNLI) and Polish (CDSCorpus). Textual entailment corpora can be obtained relatively easily for any language, which makes our approach more extensible to low-resource languages than traditional approaches based on parallel corpora. We evaluated a number of reinforcement learning algorithms (including policy gradients and actor-critic) to solve the problem of translator's policy optimization and found that our attempts yield some promising improvements over previous approaches to reinforcement-learning based zero-shot machine translation.

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