A Two-Step Approach for Aspect-Based Sentiment Analysis Using Context-Dependent Word Embeddings

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Aspect-based sentiment analysis is a popular NLP task that has the main goal to learn sentiment polarities of the given or predicted aspects. Our method to deal with this task utilises the hybrid approach proposed by Wallaart and Frasincar (2019) and enhances the overall performance using context-dependent word embeddings.

The hybrid method is a two-step approach that first computes the sentiment of aspects using a domain sentiment ontology. If the ontology reasoning is inconclusive, a neural network will be applied. The ontology has three main classes. The *SentimentValue* and *AspectMention* classes represent the polarity of an expression (positive or negative) and the corresponding concept of the aspect linked to the expression, respectively. Further on, a sentiment is assigned to an aspect based on the *SentimentMention* class and the following rules. According to the first rule a polarity is assigned to every found aspect linked to an unvarying sentiment expression (like "good"). The second rule assigns a sentiment to an aspect only if the aspect and the linked expression belong together to the same concept. The third rule solves the case of expressions with varying polarities that depend on the found aspect. Even if the ontology has a high-level of performance, it has some limitations. The ontology is unable to identify the neutral sentiment of an aspect, and can not handle the case of conflicting sentiment or when no sentiment expressions are found.

The backup model is a Left-Center-Right Separated Neural Network with Multiple Rotatory Attention (Multi-Hop LCR-Rot). Given a sentence with a target expression (aspect), we split it into three parts, namely: left context, target, and right context. The word embeddings associated with these three parts feed three bidirectional LSTMs. Next, it is applied a bilinear attention mechanism over the computed hidden states for n times (the optimal n value for our experiments is equal to 3). Precisely, the model generates new representations for both the left and the right contexts incorporating target information (Target2Context vectors). Similarly, these representations are used to acquire another two target representations with respect to the two contexts (Context2Target vectors). All these four embeddings are concatenated and the new sentence representation input a multi-layer perceptron (MLP) that predicts the final sentiment class associated with the given aspect. Figure 1 offers an overview of the model, the red lines indicate the multiple rotatory attention.

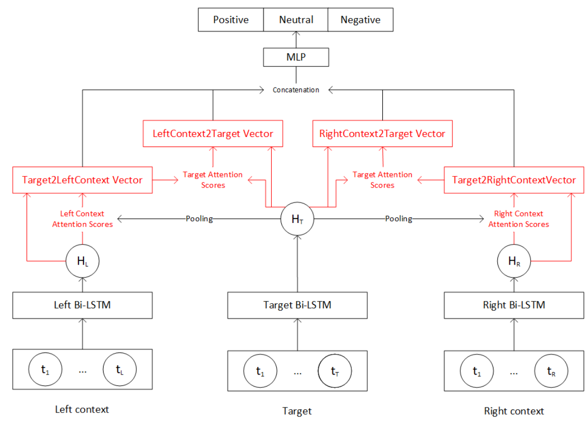

Figure 1: Multi-Hop LCR-Rot

Table 1: The in-sample and out-of-sample accuracy for GloVe and ELMo word embeddings

	GloVe	ELMo
in-sample	89.3%	90.7%
out-of-sample	86.4%	86.7%

We extend the above model and replace the GloVe word embeddings with ELMo word embeddings. The advantage of the proposed solution is that ELMo word vectors are context-dependent which means that each word has associated a different vector in different contexts. ELMo contextual representations of words are generated using two bi-directional LSTM layers in a language modeling task. The model is pre-trained on the 1 Billion Word Benchmark dataset and the length of the word vectors is set to 1024. To compare the two word embeddings, we use the SemEval 2016 restaurants dataset (Table 1). The results reveal the importance of context sensitivity specific to ELMo word embeddings over the context-independent GloVe embeddings. As our future work, we plan to compare the efficiency of the two-step approach using ELMo word vectors with other contextual word representations like BERT or OpenAI GPT.

Acknowledgments

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