Structured Representation Learning for Structured Prediction

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Abstract (should be within 1st page)

Structured prediction tasks, e.g., part-of-speech tagging, (nested) named entity recognition, and constituency parsing, are considered to be fundamental and essential techniques of natural language processing. In recent years, emerging deep-learning models, especially pre-trained language models, have provided fantastic ways to obtain informative representation, and have been continuously refreshing the leaderboards of these tasks. However, existing models typically employ universally applicable representation learning techniques, often overlooking the unique characteristics inherent to each specific task. Furthermore, lack of interpretability also keeps them a black box to humans, and the inability to explain their decision-making mechanism hindered researchers from further improving them.

In this dissertation, I mainly focus on leveraging the task-specified characteristics of these structured prediction tasks to learn structured and interpretable representations for solving these tasks.

First of all, I factorize representation according to the hierarchical structures of the nested named entity recognition task. A carefully designed algorithm is introduced to explicitly exclude the harmful influence on the best path of previous levels. By additionally introducing the chunk selection strategies and changing the encoding scheme to be the innermost first, I obtained level-wise factorized representation and also pushed the performance to better results.

Moreover, I also factorize the representation of the conventional structured prediction tasks. With the proposed contrastive hashing methods, narrowing and factoring the representation bottleneck to be only 24 bits without (almost) losing performance becomes feasible. These learned discrete bits are demonstrated completely preserving the necessary features of the downstream tasks, therefore, providing researchers with a more interpretable tool to analyze the internal mechanism of the black-box neural networks.

The main contribution of this dissertation is that I proposed two representation learning methods to learn structured representation for structured prediction tasks. Numerous experiments and discussions are further provided to show the effectiveness and efficiency of my methods.