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Semantic Label Enhanced Named Entity Recognition with Incompletely Annotated Data

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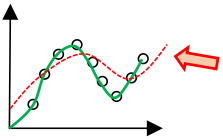
I. Introduction

	Ellen	Show		Seanson 14			American	talk show		
	艾	伦	秀	第	十	四	季	美	国	脱	口	秀
A1:	B-TV	I-TV	E-TV	B-NUM	I-NUM	I-NUM	E-NUM	O	O	O	O	O
A2:	B-PER	I-PER	O	B-NUM	I-NUM	I-NUM	E-NUM	O	O	O	O	O
A3:	B-TV	I-TV	E-TV	O	O	O	O	O	O	O	O	O
A4:	O	O	O	O	O	O	O	O	O	O	O	O

In most previous Name Entity Recognition(NER) works, entities are assumed to have fully annotated labels. Nevertheless, obtaining high-quality annotations is usually laborious and time-consuming in industrial scenarios. In this paper, a novel semantic label enhanced named entity recognition model is proposed to tackle with NER problems with incompletely annotated data. The figure above indicates our training data, where A1 is the correct annotation and A2 to A4 is incompletely annotated data.

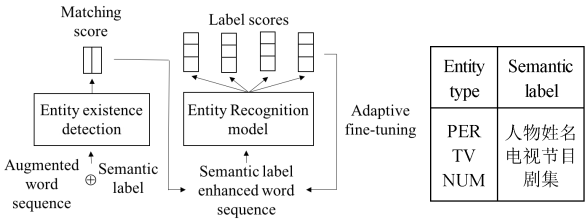
II. Motivation

※ External Knowledge is able to enhance performance.
※ Two essential aspect in NER:
New Entity Discovery & Entity Border Prediction
※ Two-stage models are popular in triplet extraction.
※ Weak semantic constraint for getting better results.



Weak prior constraint(Semantic labels)

III. Methodology



※ Entity existence detection

The input of the entity existence detection model is constructed by concatenating augmented word sequence and every element in semantic label set for getting interaction info. The output of BERT's last layer on "[CLS]" position is utilized as the entity existence features and combined linearly with weight w .

※ Semantic label enhanced entity recognition

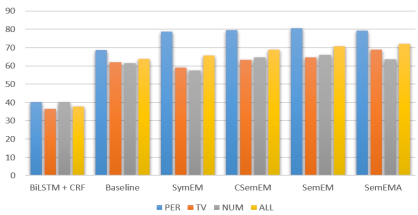
Utilizing entity existence detection model for unlabeled sequence semantic label generation. Then put all semantic label enhanced data into a k-fold cross validation, self learning architecture[1] for training semantic enhanced model(SemEM).

$$\mathcal{L}(\theta) = -\sum_{i} log \sum_{y \in C(y^i_{pl})} q\mathcal{D}_l(y|x^i_l))p_\theta(y|x^i_l))$$

※ Adaptive Fine-tuning

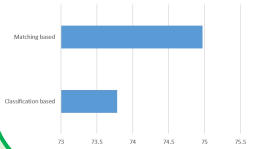
If an entity is recognized by the semantic label enhanced model also occurs in the segmentation result[2] from the same word sequence, it will be added into the entity dictionary for new annotation. Then train the model through new annotation.

IV. Exp. & Results



※ Every model that we implement receives more than 1.5 percent improvement compared with the Baseline model[1]. Especially, SemEMA model reaches F1 score 71.96 with a **7.98** absolute increment on baseline model.

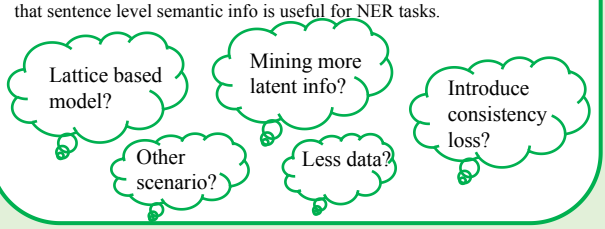
※ Compared with the symbolic label, transferring entity existence detection result into semantic label shows more compatibility and could reach a better result.



※ Although adaptive fine-tuning leads to overall improvements, false positive predictions are also brought.

V. Conclusion & Future work

※ In this work, our model mainly includes a matching based method to detect entity existence and generate semantic labels, and a semantic label enhanced approach to recognize entities. Notably, the importance of semantic label is proved through controlled trials. According to our study, mining more befitting latent info as constraint in semi-supervised task could lead improvements than conventional methods. Moreover, we proved that sentence level semantic info is useful for NER tasks.



References

[1] Zhanming Jie, Pengjun Xie, Wei Lu, Ruixue Ding, and Linlin Li. Better modeling of incomplete annotations for named entity recognition. In Proceedings of the 2019 NAACL: Human Language Technologies, Volume 1 (Long and Short Papers), pages 729{734, 2019.

[2]Zhenyu Jiao, Shuqi Sun, and Ke Sun. Chinese lexical analysis with deep bi-gru-crf network. *arXiv preprint arXiv:1807.01882*, 2018.

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Interest:
※ Knowledge acquisition with low resource
※ Knowledge Graph
※ Semi-supervised learning