

# **JBNU at MRP 2019: Multi-level Biaffine Attention for Semantic Dependency Parsing**

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# Introduction

- Our issue: **Multi-task learning** for **DM/PSD/UCCA**
  - To enable **multi-task learning**, we explicitly make **shared common components** in a neural network architecture across different frameworks
- Models
  - **Biaffine attention**: we propose a unified neural model for the **DM/PSD/UCCA** frameworks based on the biaffine attention [Dozat and Manning, 2017, 2018; Zhang et al., 2019]
  - **Multi-level biaffine attention**:
    - Motivated by the multi-level architecture of FusionNet in the machine reading comprehension task [Huang et al., 2018]

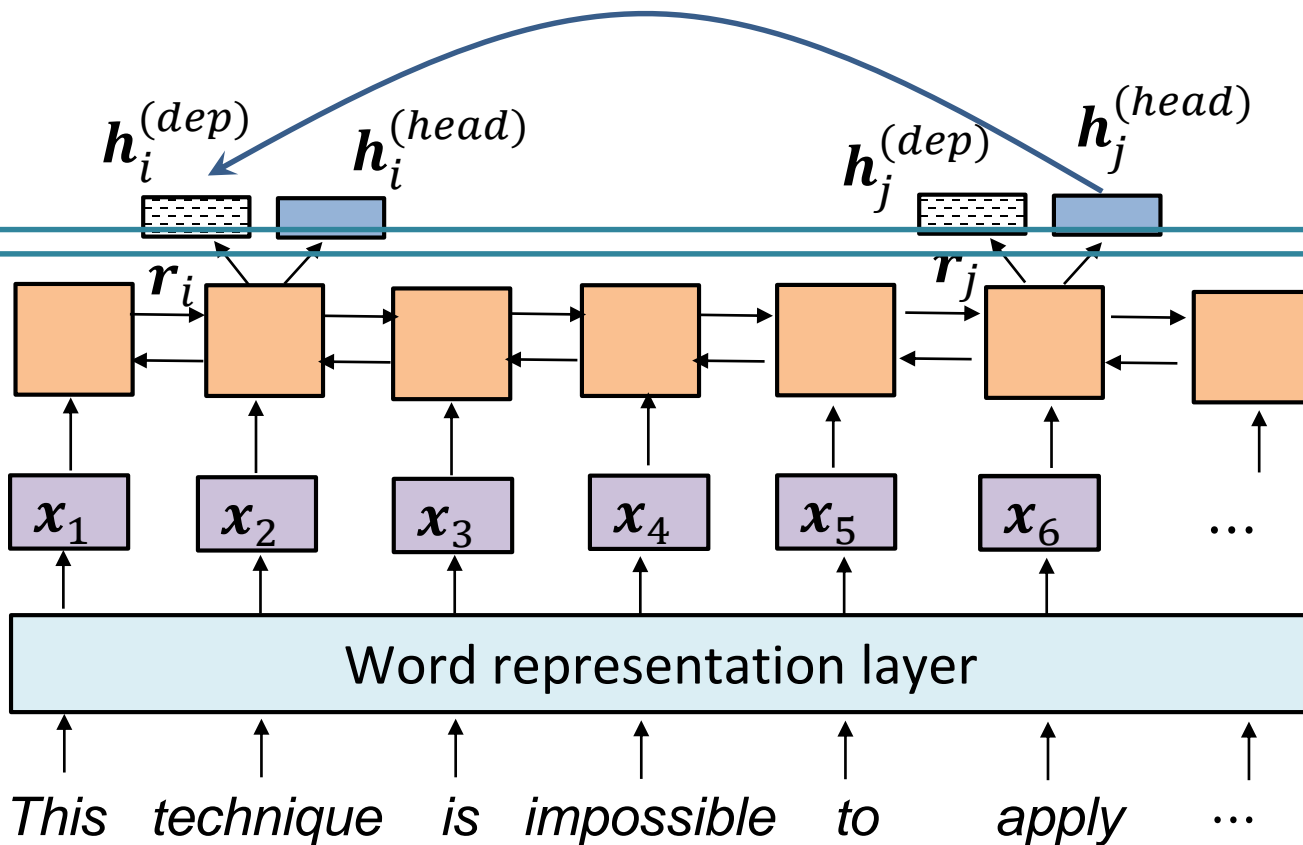
DM

PSD

UCCA



**Decoder: Biaffine attention** ← **framework specific**

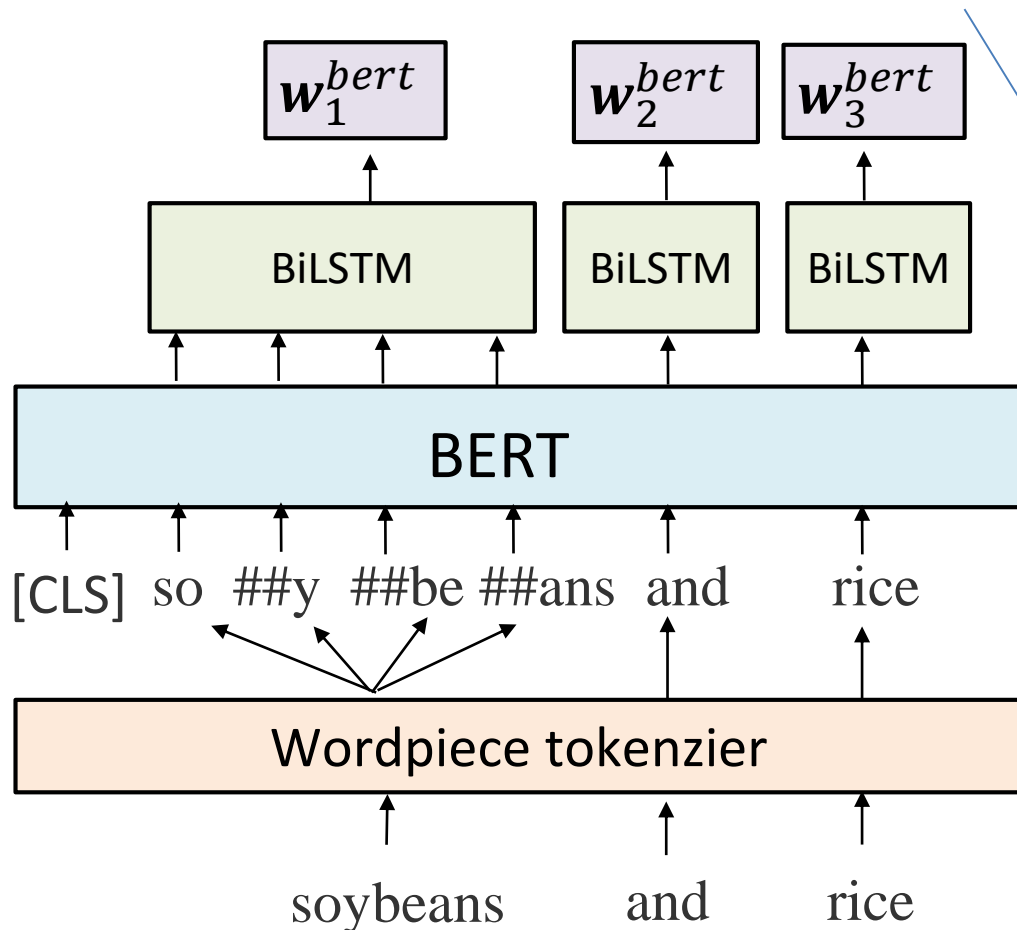


**Encoder: BERT-BiLSTM** ← **shared across frameworks**

# Encoder: BERT-BiLSTM (shared across frameworks)

- **Word representation layer using BERT**

Given a sentence, **the BERT encoder** is applied to its wordpieces and the encoded wordpiece-level representations are composed to the word-level embeddings based on BiLSTM



**BERT word-level embedding**

$$\mathbf{x}_i = \left[ \mathbf{w}_i^{bert}; \mathbf{e}_i^{glove}; \mathbf{e}_i^{POS} \right]$$



**BiLSTM sentence encoding**

$$\mathbf{r}_i = BiLSTM_i(\mathbf{x}_1 \cdots \mathbf{x}_n)$$

# Decoder: Biaffine attention (framework specific)

- Biaffine attention is performed on the role-dependent representations to predict the existence of an edge and its labels

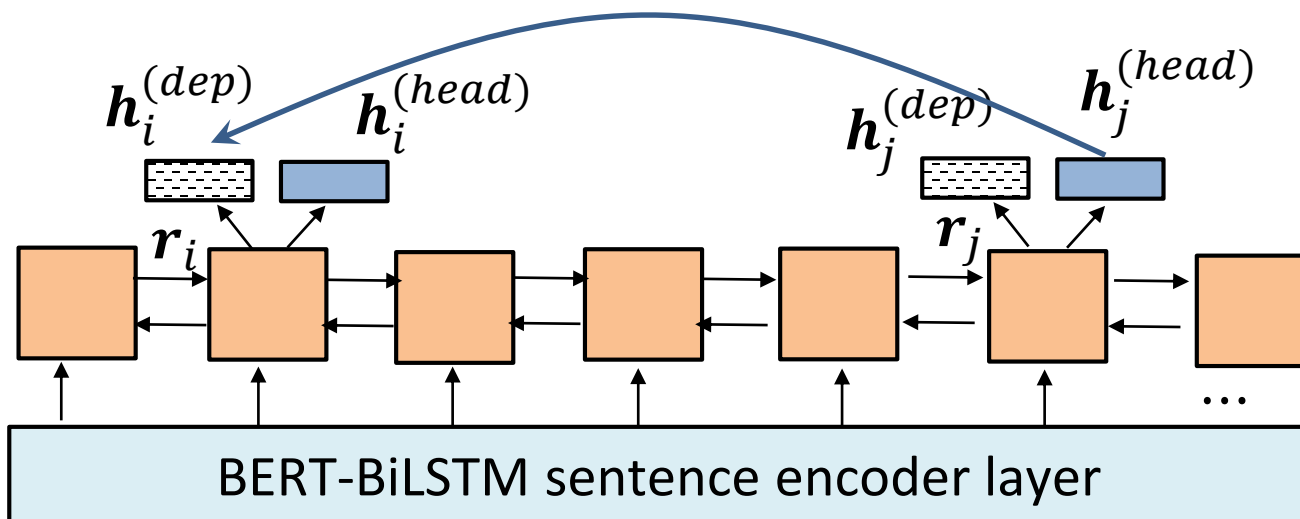
## Biaffine attention

$$BiAff_m(\mathbf{x}, \mathbf{y}) = \mathbf{x}^T \mathbf{U}^{[1:m]} \mathbf{y} + \mathbf{V} \begin{bmatrix} \mathbf{x} \\ \mathbf{y} \end{bmatrix} + \mathbf{b}$$

$$s_{i,j}^{(edge)} = BiAff_1^{(edge)} \left( \mathbf{h}_i^{(dep)}, \mathbf{h}_j^{(head)} \right)$$

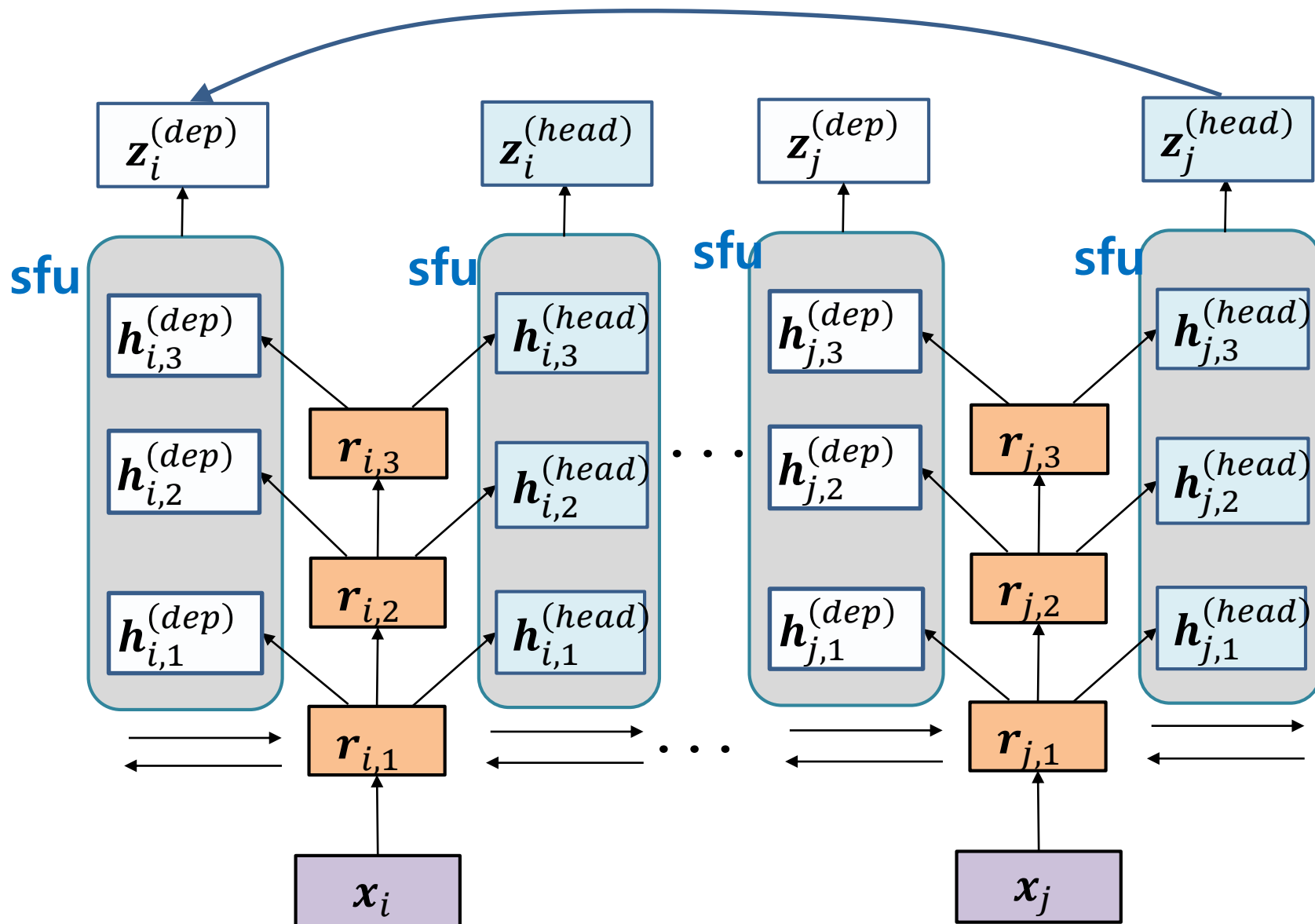
$$s_{i,j}^{(label)} = BiAff_k^{(label)} \left( \mathbf{h}_i^{(l-dep)}, \mathbf{h}_j^{(l-head)} \right)$$

$$s_i^{(top)} = FFN^{(top)}(\mathbf{r}_i)$$



# Multi-level Biaffine attention

The hidden representations at three levels are composed to the final hidden representation  $\mathbf{z}_i^{(dep)}$ ,  $\mathbf{z}_i^{(head)}$  using a **semantic fusion unit**



# Preliminary Experiment

For more details, please visit our poster.  
Thank you.

Framework	Train	Dev
DM	32091	3565
PSD	32091	3565
UCCA	5915	656

method	DM			PSD			UCCA		
	Top	UF	LF	Top	UF	LF	Top	UF	LF
Biaffine	93.67	92.08	90.86	95.97	90.50	78.21	72.60	69.67	65.17
BERT+Biaffine	95.06	93.85	93.00	96.89	92.30	80.24	77.09	74.85	70.15
BERT+Multi-level Biaffine	95.09	93.86	93.02	96.76	91.95	79.76	78.12	74.42	69.81
BERT+Biaffine+MTL	N/A	93.66	92.73	N/A	92.13	79.63	N/A	75.40	70.59

- **BERT+Biaffine performs** better than Biaffine, in particular, obtaining the increases of about 5% for UF and LF on the UCCA framework
- **BERT+Multi-level Biaffine** does not achieve any further improvements with respect to BERT-Biaffine model
- **BERT+Biaffine+MTL** only achieves small improvements on UCCA framework whereas no improvements on DM and PSD frameworks can be observed