Recursive Subtree Composition in LSTM-Based Dependency Parsing

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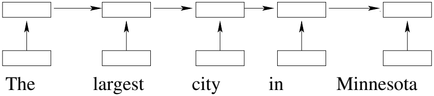
Overview

1. Tree vs. sequential LSTMs for parsing
2. BiLSTM parsing
3. Results
4. Conclusion

Outline for section 1

Recursive vs recurrent NNs

Recurrent



Recursive vs recurrent NNs

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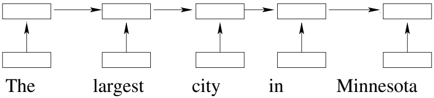
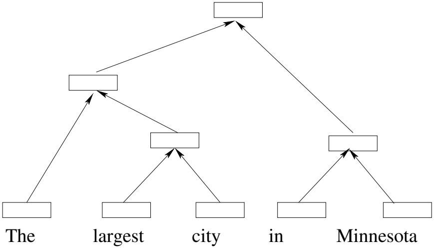


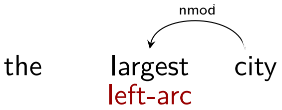
Recursive



Recursive NN for Transition-Based Parsing

the largest city

Recursive NN for Transition-Based Parsing



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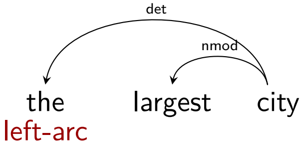

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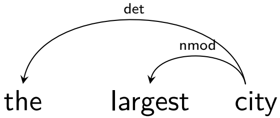
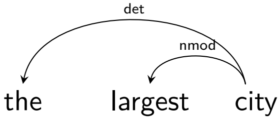


Recursive composition function in the stack-LSTM parser (Dyer et al., 2015):

Recursive NN for Transition-Based Parsing



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$$c(h, d, r) = tanh(W[h; d; r] + b)$$

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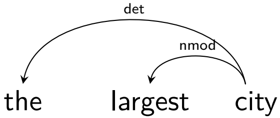

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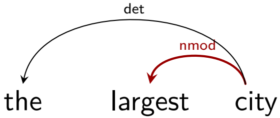
Recursive NN for Transition-Based Parsing



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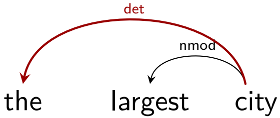
$$city_1 = c(city_0, largest, left - nmod)$$

Recursive NN for Transition-Based Parsing



Recursive composition function in the stack-LSTM parser (Dyer et al., 2015):

$$
\begin{aligned}
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city_1 &= c(city_0, largest, left - nmod) \\
city_2 &= c(city_1, the, left - det)
\end{aligned}
$$

Recursive vs recurrent NNs

Recursive vs recurrent NNs

	English PTB	Chinese CTB

Recursive vs recurrent NNs

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S-LSTM without composition	89.6	83.6

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Goals

Recursive vs recurrent NNs

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- BiLSTM + composition?
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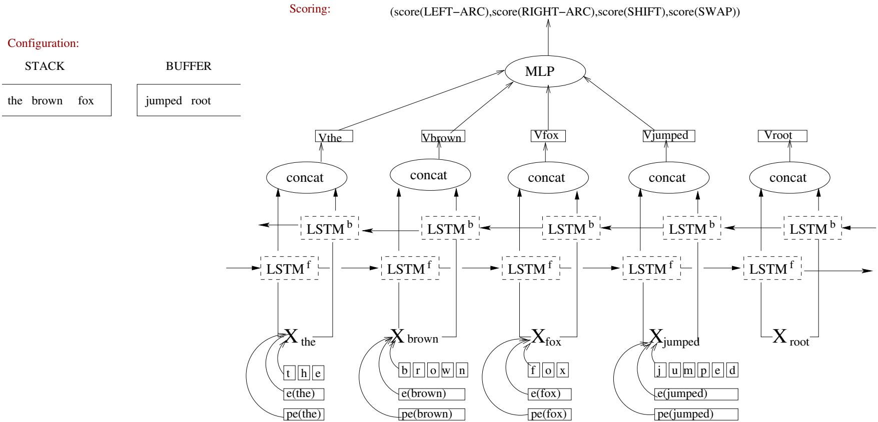
Goals

- BiLSTM + composition?
- Examine composition in simple architecture
- Typologically varied languages

Outline for section 2

Transition-Based Parsing using BiLSTMs

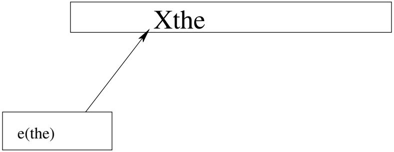


Kiperwasser and Goldberg (2016); de Lhoneux et al. (2017)

Transition-Based Parsing using BiLSTMs

Xthe

Transition-Based Parsing using BiLSTMs



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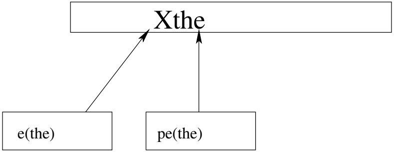

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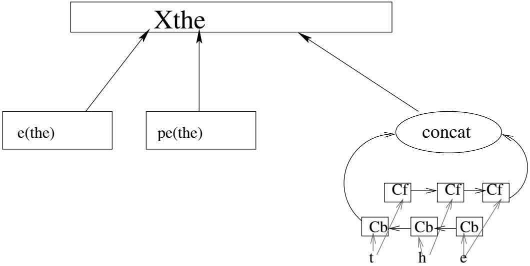
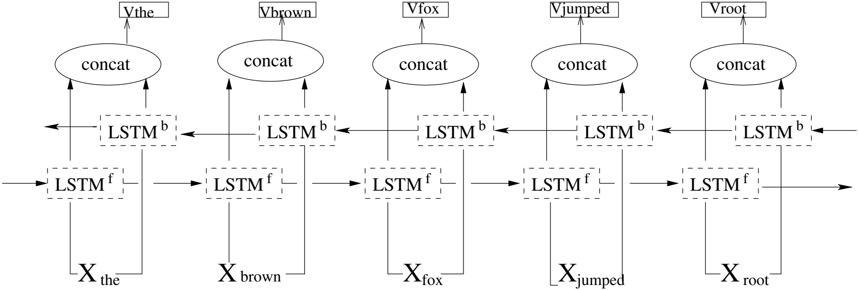


Transition-Based Parsing using BiLSTMs

X_{the} X_{brown} X_{fox} X_{jumped} X_{root}

Transition-Based Parsing using BiLSTMs



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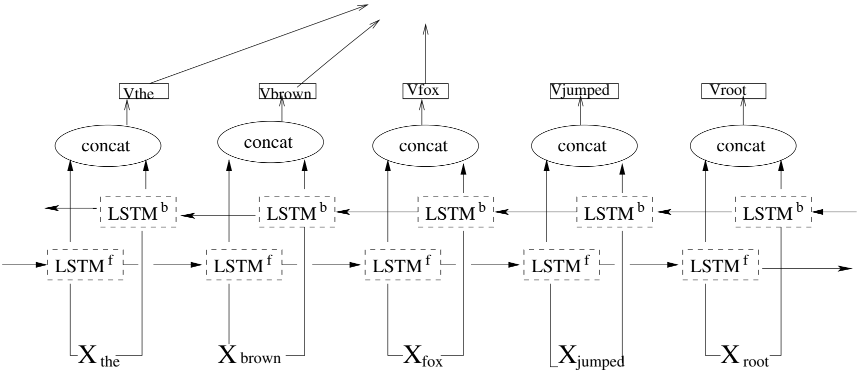

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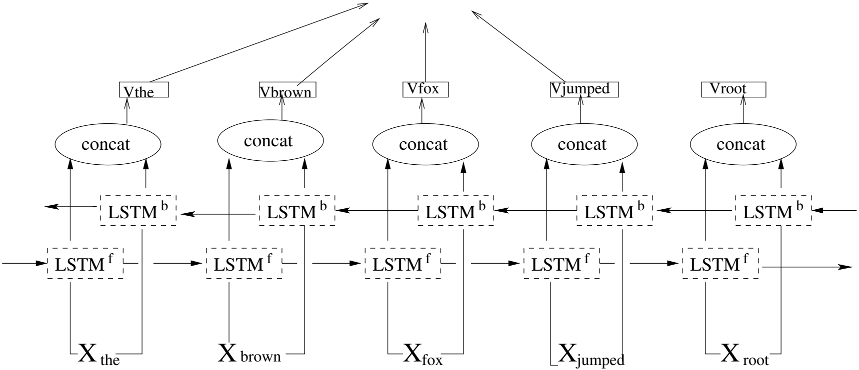

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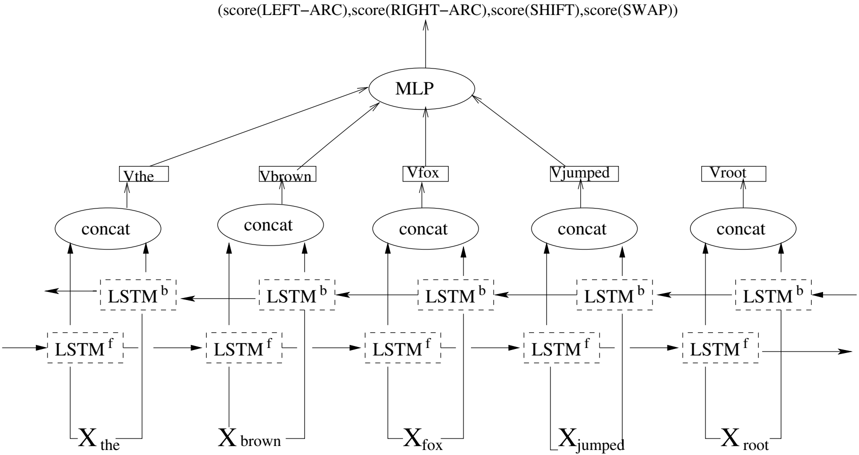
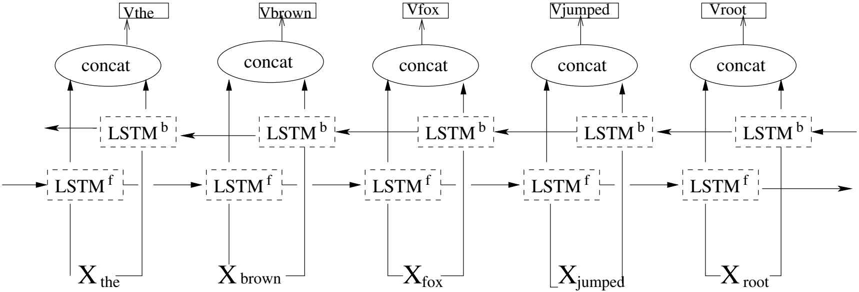


Recursive Composition in the BiLSTM parser



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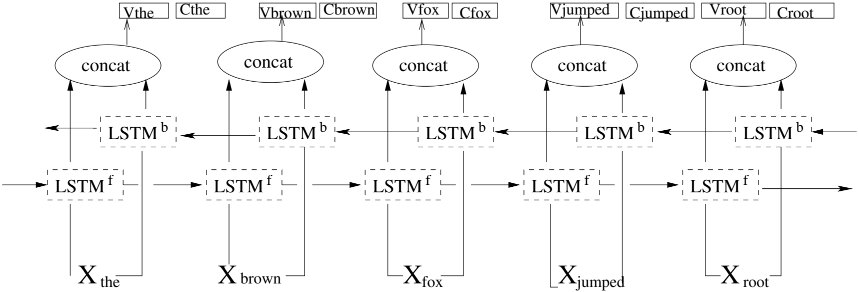

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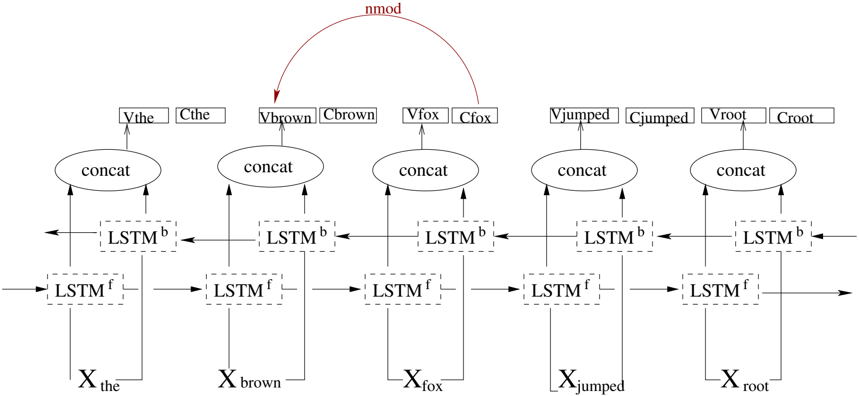
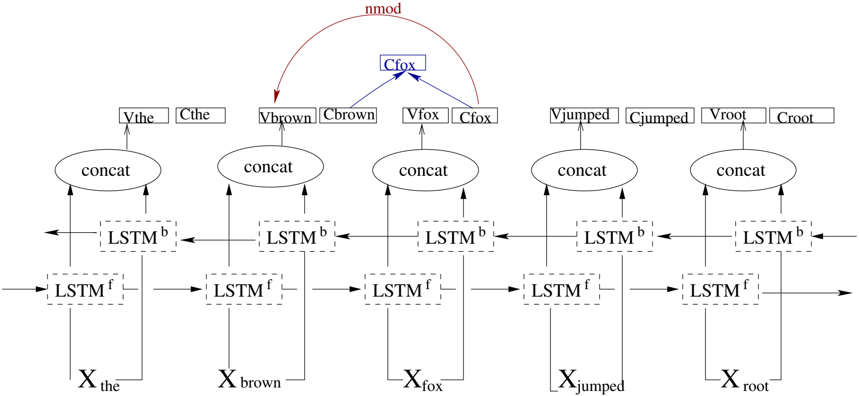


Recursive Composition in the BiLSTM parser



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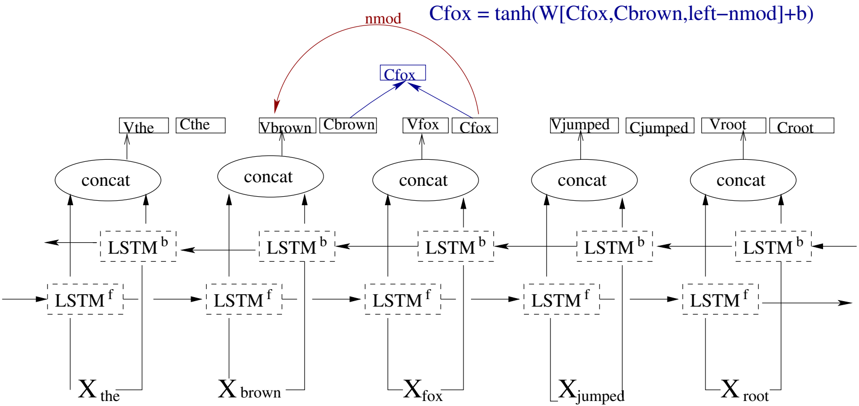

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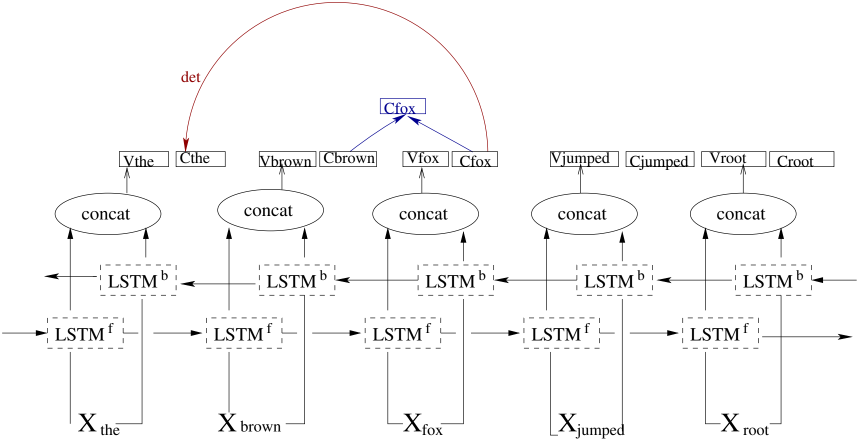

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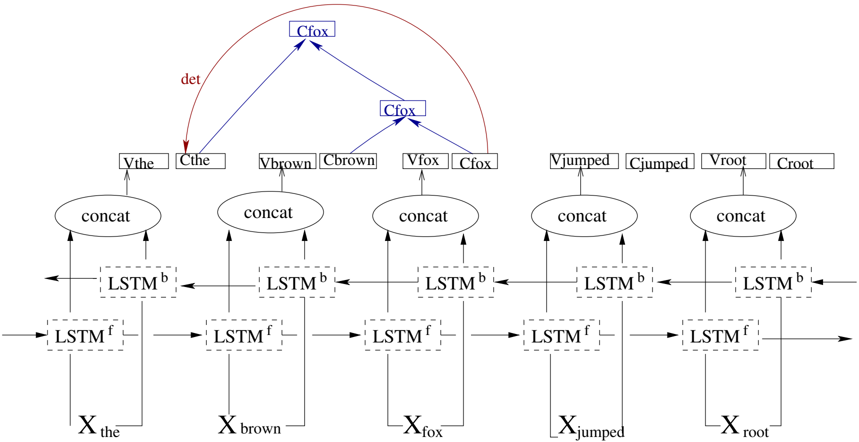

Recursive Composition in the BiLSTM parser

$$c_{head} = tanh(W[h; d; r] + b)$$

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$$c_{head} = tanh(W[h; d; r] + b) + rc$$
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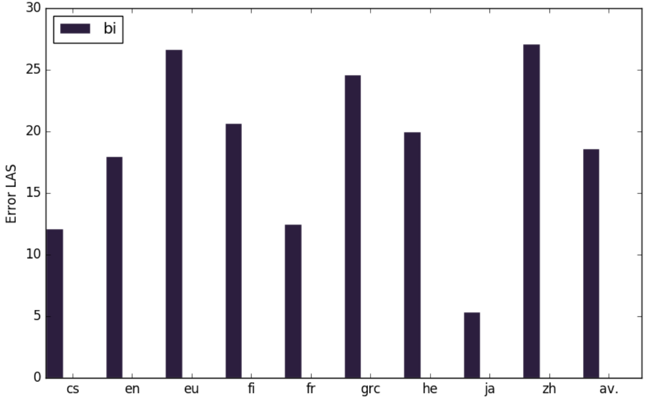
Outline for section 3

Results: BiLSTM + composition



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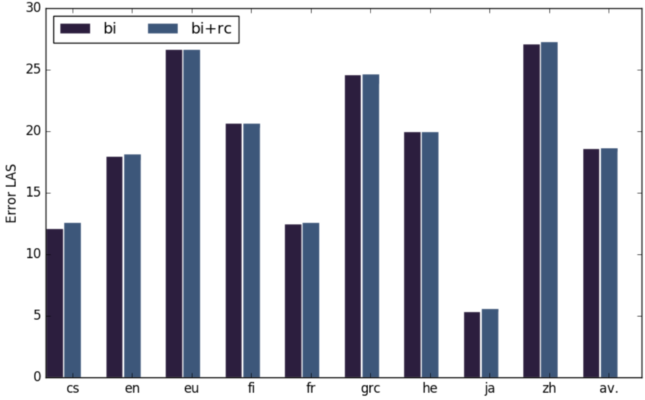

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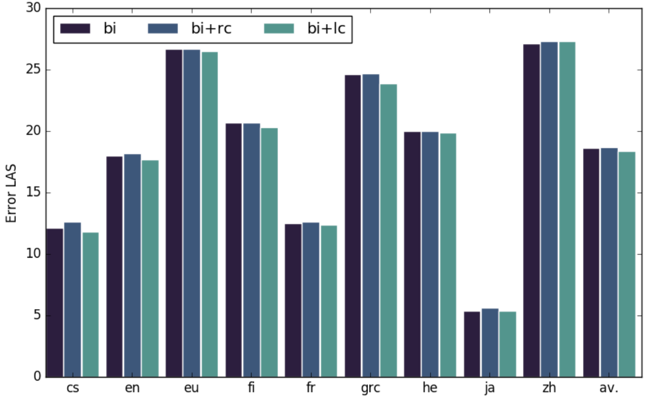
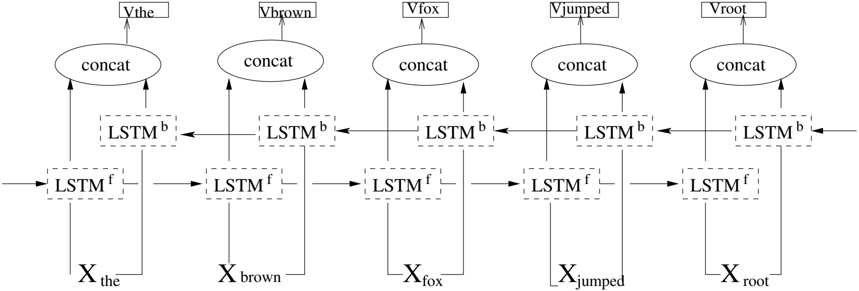


LSTM Feature Extractors



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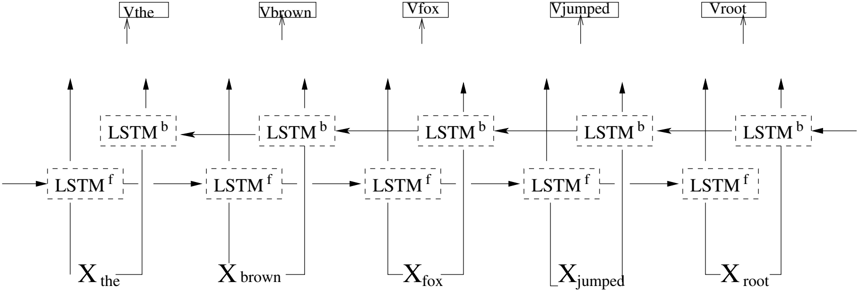

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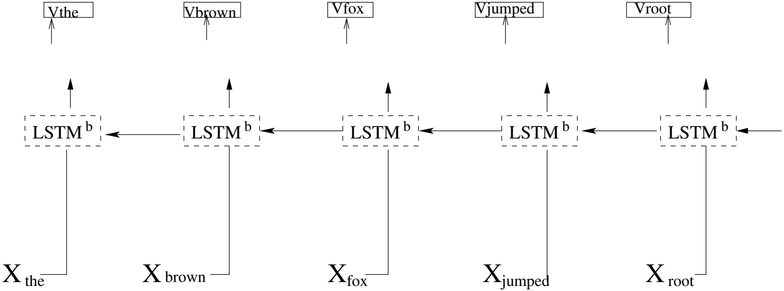

bw

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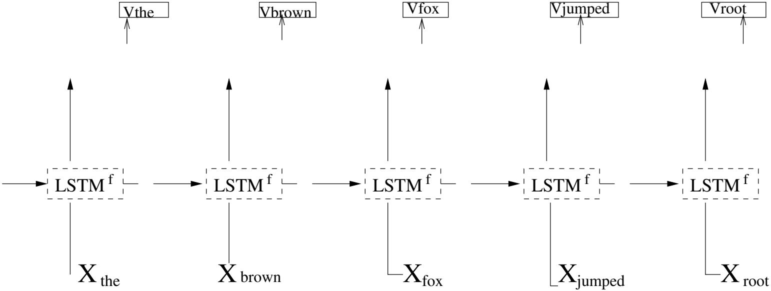

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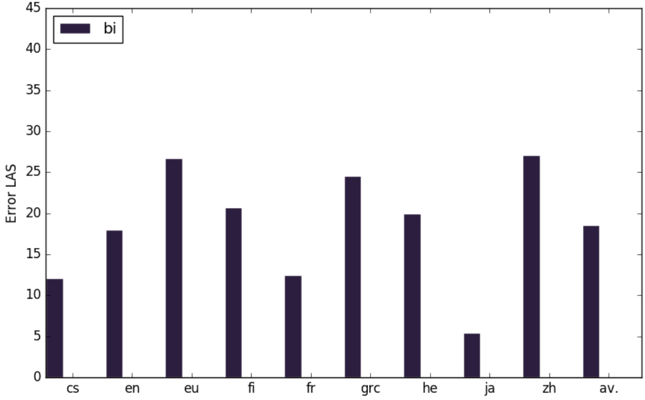
Results: BiLSTM ablations



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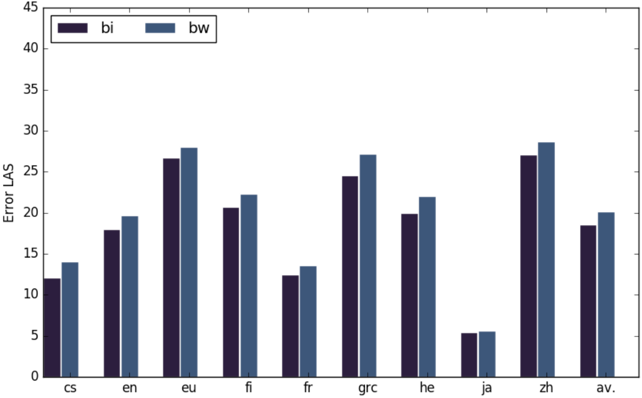

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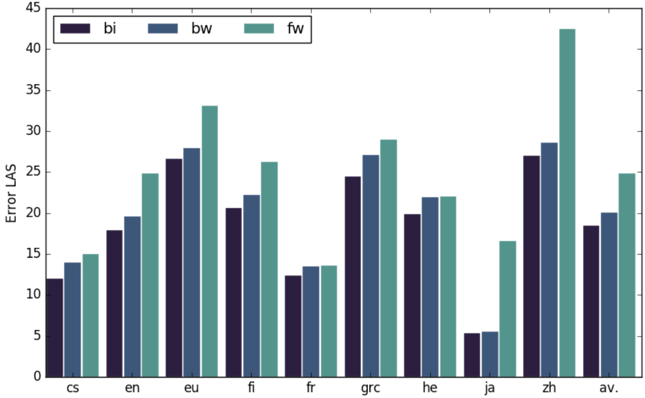
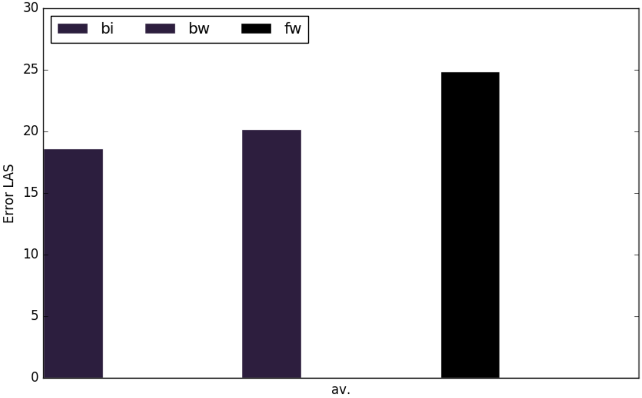


Results: BiLSTM ablations + composition



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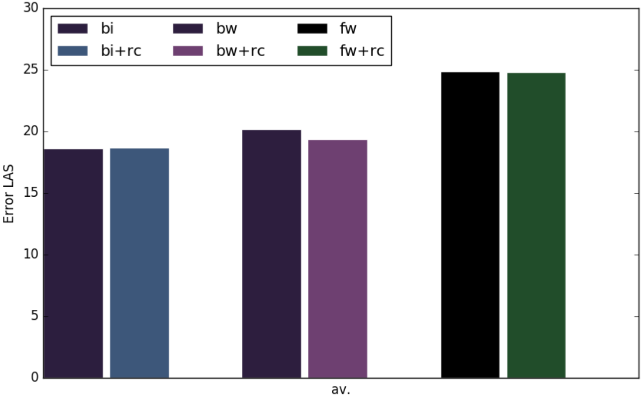

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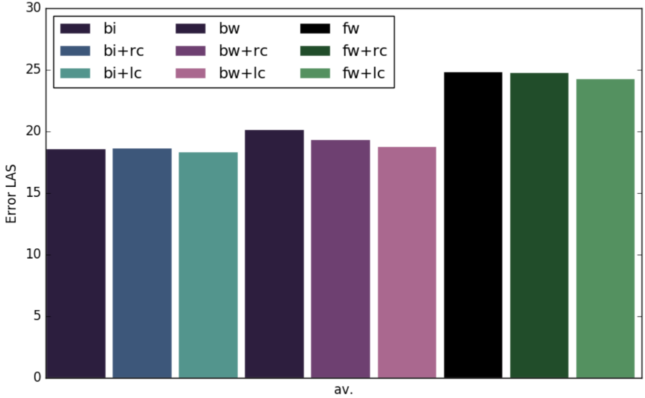
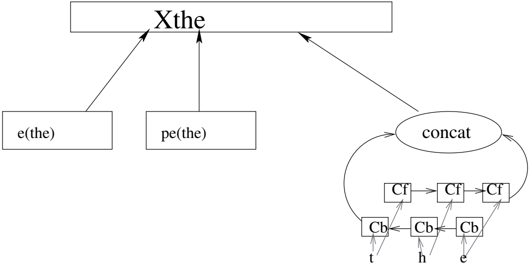


Word representation



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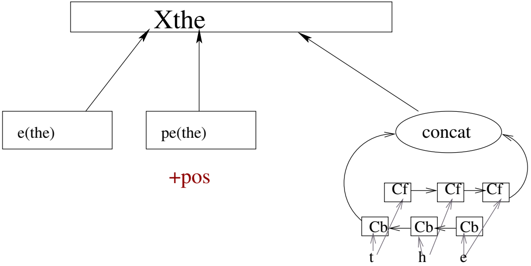

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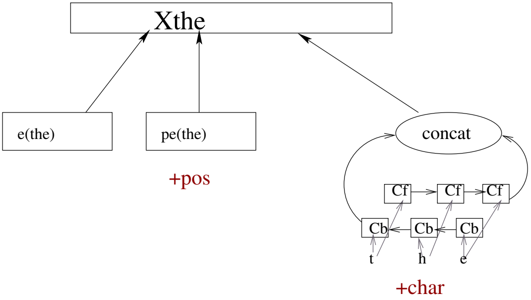

Composition gap recovery

	[bw+lc]-bw	[fw+lc]-fw
pos+char+	1.4	0.6
pos+char-	1.3	0.6
pos-char+	1.6	0.7
pos-char-	2	1

av.

Composition gap recovery

	[bw+lc]-bw	bi-bw	%rec.	[fw+lc]-fw	bi-fw	%rec.
pos+char+	1.4	1.6	87.5	0.6	6.3	9.5
pos+char-	1.3	1.8	72.2	0.6	6.6	9.1
pos-char+	1.6	1.9	84.2	0.7	7.3	9.6
pos-char-	2	3.1	64.5	1	8.7	11.5

av.

Outline for section 4

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Conclusion

- Subtree composition does not reliably help a BiLSTM transition-based parser
- The backward part of the BiLSTM is crucial, especially for right-headed languages
- The forward part of the BiLSTM is less crucial
- A backward LSTM + subtree composition performs close to a BiLSTM
- POS information and subtree composition are two partially redundant ways of constructing contextual information

References

Miryam de Lhoneux, Yan Shao, Ali Basirat, Eliyahu Kiperwasser, Sara Stymne, Yoav Goldberg, and Joakim Nivre. 2017. From raw text to universal dependencies - look, no tags! In *Proceedings of the CoNLL 2017 Shared Task: Multilingual Parsing from Raw Text to Universal Dependencies*. Association for Computational Linguistics, Vancouver, Canada, pages 207–217.

Chris Dyer, Miguel Ballesteros, Wang Ling, Austin Matthews, and Noah A. Smith. 2015. Transition-based dependency parsing with stack long short-term memory. In *Proceedings of the 53rd Annual Meeting of the Association for Computational Linguistics and the 7th International Joint Conference on Natural Language Processing of the Asian Federation of Natural Language Processing, ACL 2015, July 26-31, 2015, Beijing, China, Volume 1: Long Papers*. pages 334–343. http://aclweb.org/anthology/P/P15/P15-1033.pdf.

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