Neural Supertag-based Parsing for Tree Wrapping Grammars

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Tree Wrapping Grammar (TWG)

- Finite set of elementary trees, combined via:
  - → (simple) substitution,
  - → sister adjunction,
  - → wrapping substitution (Kallmeyer et al., 2013; Osswald and Kallmeyer, 2018).

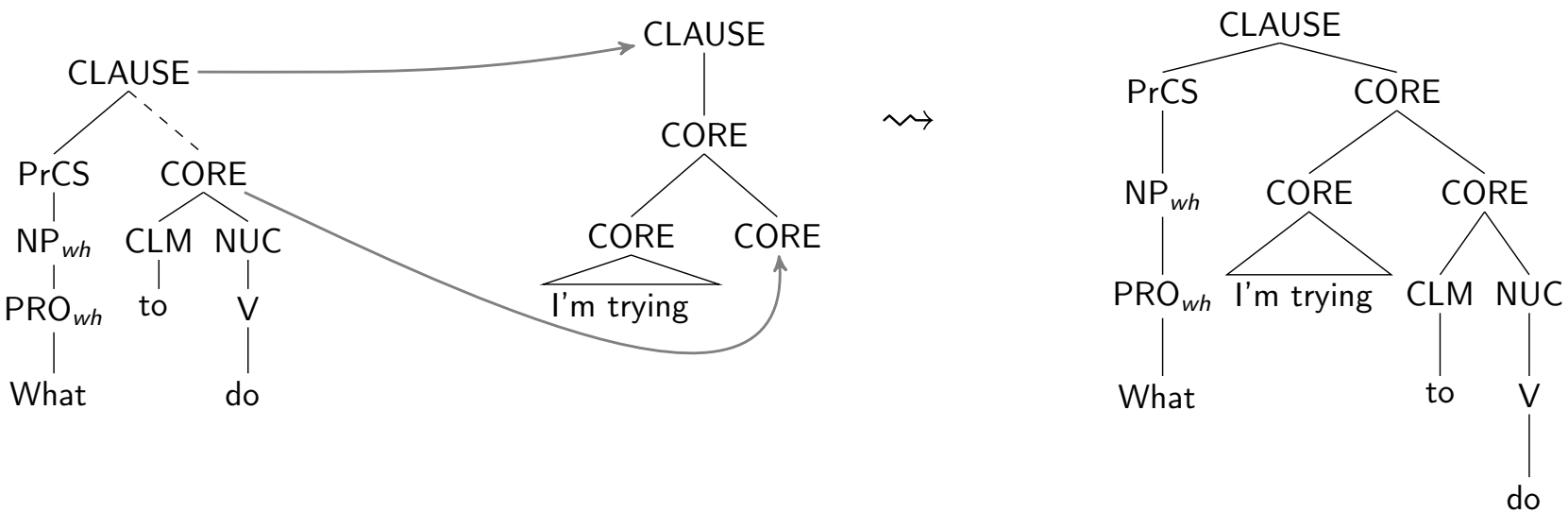


Figure 1: Wrapping substitution and a long distance dependency (LDD).

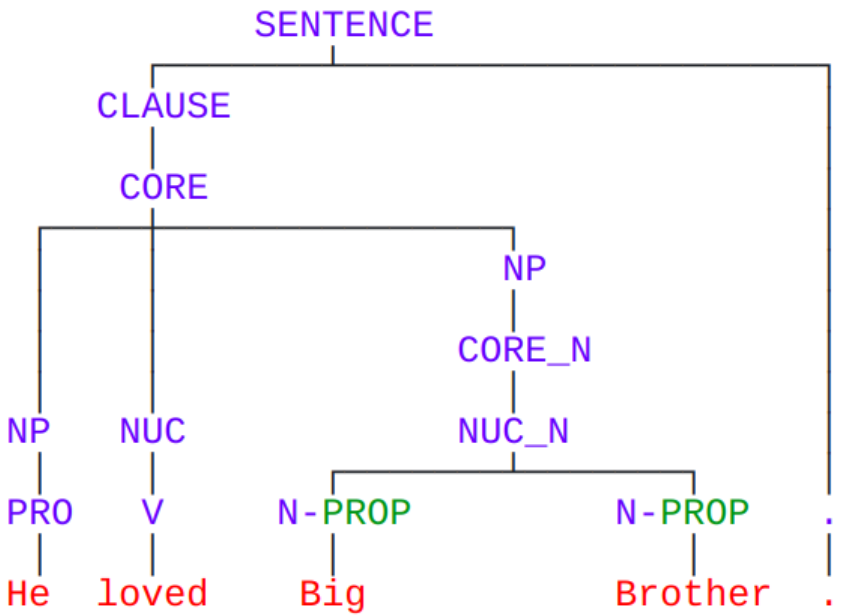
RRGbank and RRGparbank

- Corpora of RRG annotated sentences

  → RRG = Role and Reference Grammar (Van Valin and LaPolla, 1997; Van Valin Jr, 2005)

- PTB and George Orwell's novel '1984' with translations

  → annotated with RRG structures.



TWG Extraction: initial and auxiliary trees

- TWG extraction algorithm based on Xia (1999) for TAG.
- Percolation tables for head and modifier distinction.

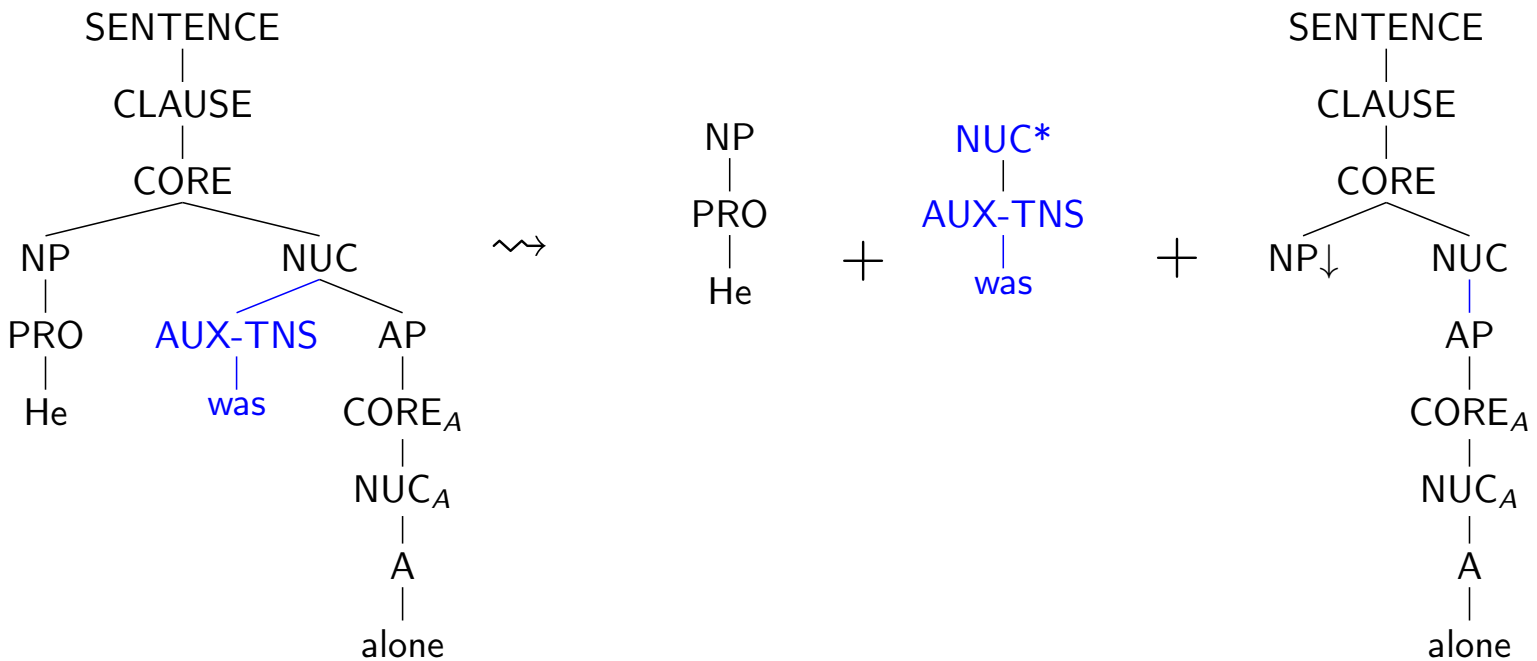


Figure 2: Extraction of initial and sister-adjoining trees.

TWG Extraction: d-edge trees for LDDs

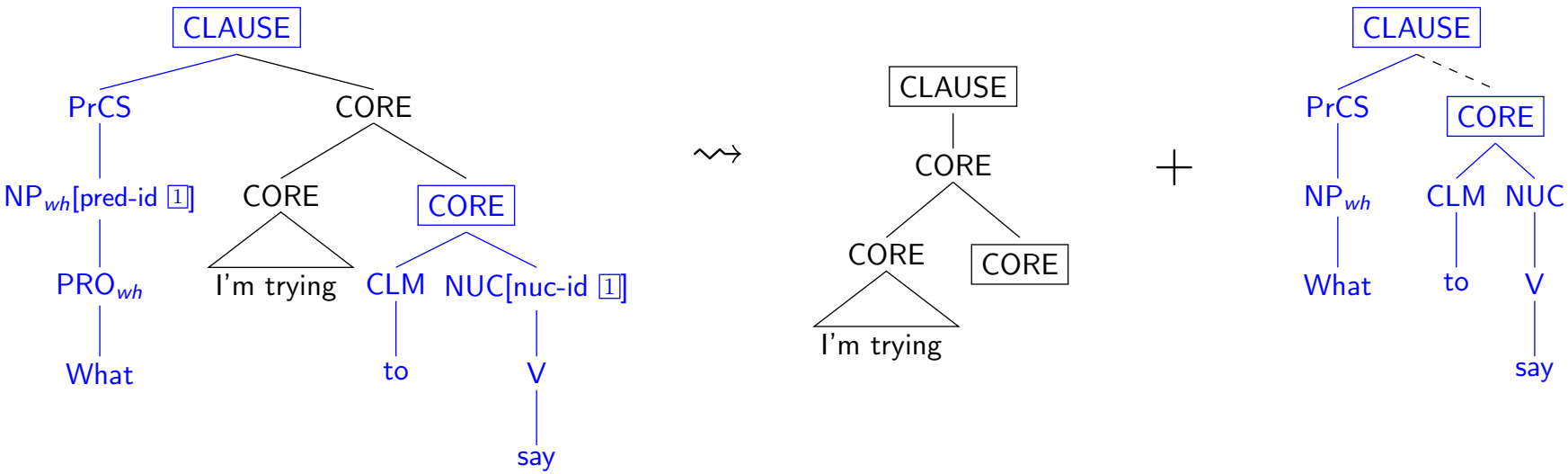


Figure 3: Extraction of a target tree and an elementary tree with a long distance dependency (LDD).

Extracted TWG Grammar

Parameters	TWG
Supertags	**3125**
Supertags occuring once	**1858**
Avg. sentence length	10.97
Sentences	7656
# initial trees	1527
# sister-adjoining trees	1549
# d-edge trees	49
# Long-dist. dependencies (LDDs)	**78**

Table 1: Statistics on subcorpora and extracted grammars.

Parsing architecture

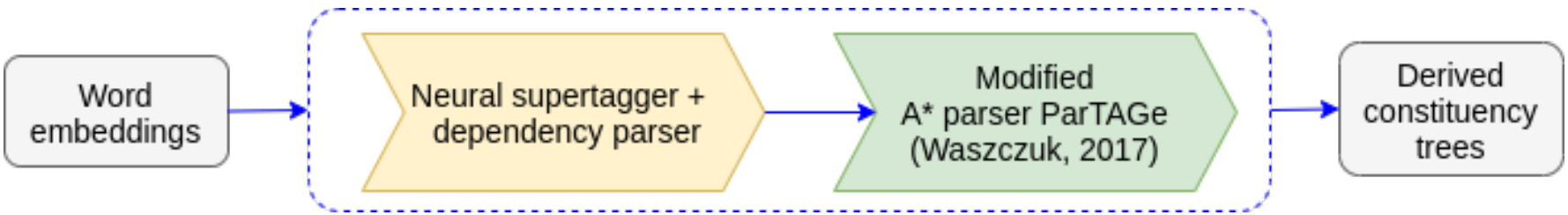


Figure 4: Pipeline of our neural statistical TWG parsing architecture.

Evaluation

- Train, dev, and test split: 4960, 551, and 2145 sentences

	DiscoDOP		Discoparset		ParTAGe	
	dev	test	dev	test	dev	test
Unlabeled Attachment Score	–	–	–	–	87.74	87.67
Supertagging accuracy	–	–	–	–	74.25	75.81
POS-tagging accuracy	92.02	93.25	$94.24_{(+3.04)}$	$94.92_{(+2.69)}$	**94.63**	**95.07**
Exactly matching parses	29.04	32.87	$28.68_{(+8.89)}$	$28.30_{(+13.19)}$	**36.12**	**38.32**
Labeled F1	79.26	80.96	$83.57_{(+6.83)}$	$84.56_{(+6.39)}$	**85.26**	**85.26**

Table 2: Parsing results compared with DiscoDOP[1] and Discoparset[2]. The numbers in subscript represent the relative gain provided by BERT[3].

[1] DiscoDOP (van Cranenburgh et al., 2016)
[2] Discoparset (Coavoux and Cohen, 2019)
[3] BERT (Devlin et al., 2019)

Errors in LDD prediction

Predicted LDDs	**DiscoDOP**	**Discoparset**	**ParTAGe**
	test	test	test
# true positives	13	14	**22**
# false positives	7	0	0
# false negatives	14	13	**5**

Table 3: Prediction of long-distance dependencies (LDDs) on test data.

Error analysis for LDD prediction

- Errors in POS-tag predictions.

  What is one ***to think*** *of all this?* (*is* tagged AUX instead of V)

- Wrong attachment of an LDD part (if the relative or wh phrase of the LDD is an adjunct).

  And why do you imagine that we ***bring*** *people to this place?*

- Cases where the embedding verb also has a strong tendency to take a wh-element as argument.

  [. . .] slip of paper which they said ***was the bill***

Perspectives

Linguistic resources

- Corpus-based wide-coverage RRG grammar for English
- Proof of concept for TWG, in particular wrt. non-local dependencies

Parsing

- Wide-coverage probabilistic parsing with TWGs
- Capturing LDDs in constituency parsing

THANK YOU VERY MUCH FOR YOUR ATTENTION!

References I

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