Chart-based RRG parsing using an automatically extracted RRG grammar with features

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Overview

Design of RRG Grammars

Automatic RRG Grammar Extraction

Parsing experiments

Issues

Summary & Outlook

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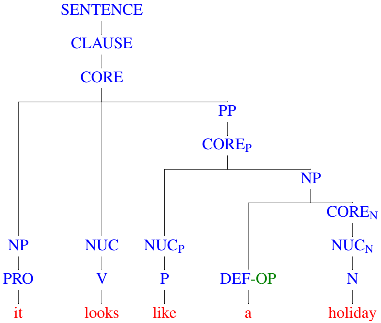
1. RRG annotated treebank: RRGBank [2],
2. extract RRG elementary trees automatically,
3. use these elementary trees for RRG parsing.



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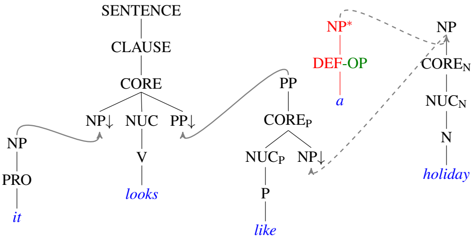

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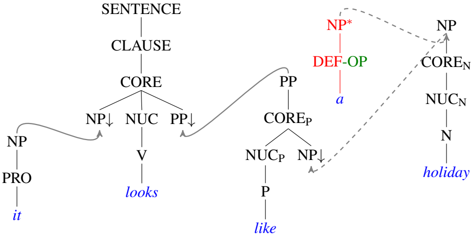

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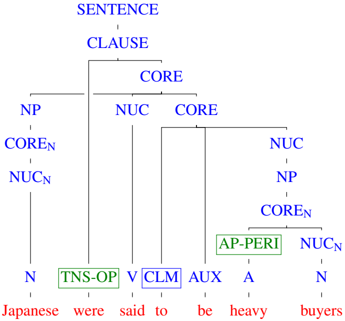
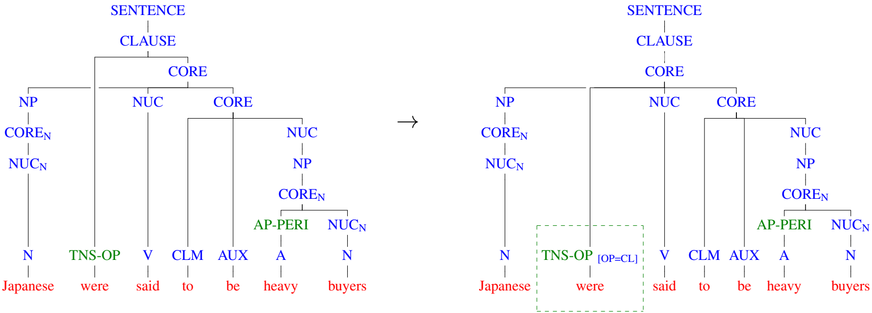
RRGbank

- ⋆ Corpus of RRG annotated sentences [2]
  → automatically converted from Penn Treebank,
  → manually checked and validated;
- ⋆ 395 gold sentences, 1090 silver annotated sentences;
- ⋆ RRGbank and RRG annotation tool: rrgbank.phil.hhu.de.



Removing crossing branches



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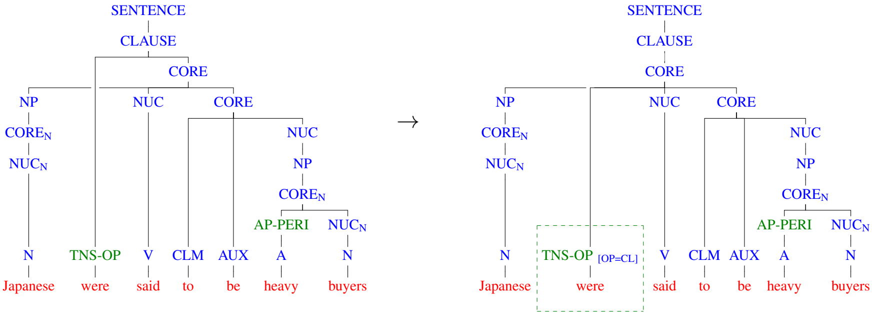

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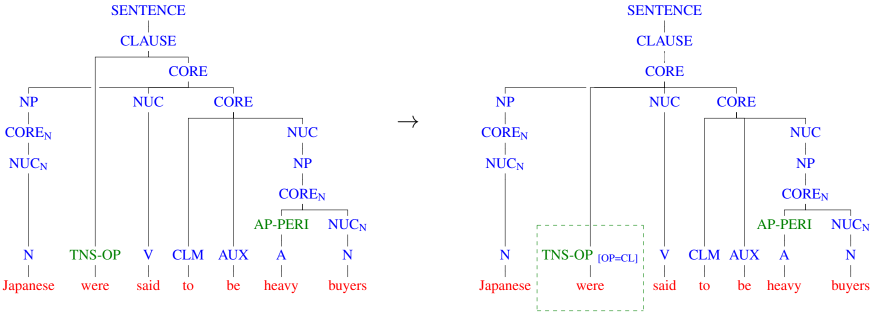
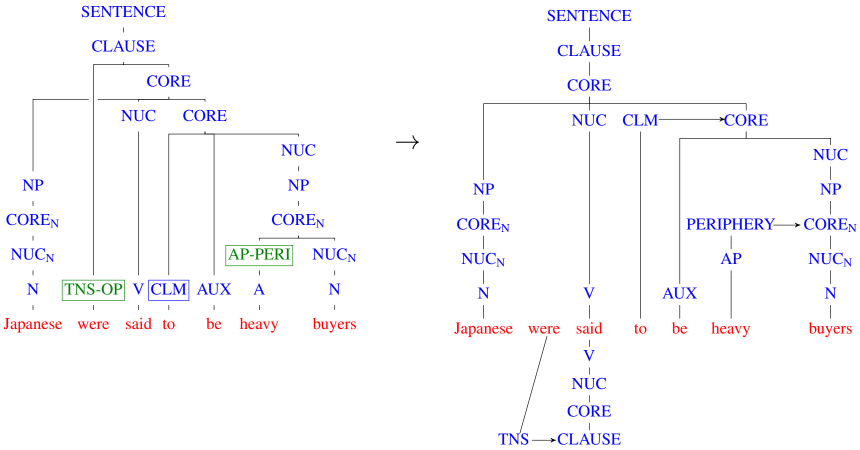


- ⋆ we transform the RRG structures to remove crossing branches,
- ⋆ we mark the original position of the node with [OP=CL],
- ⋆ original tree structure is easily recovered.

Operator projection and periphery can be recovered



Elementary trees in RRG Grammars

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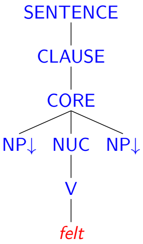
- ⋆ Three tree composition operations:
  → *substitution* (argument slot filling)
  → *wrapping substitution* (displaced argument slot filling)
  → *sister adjunction* (adding operators and periphery elements);

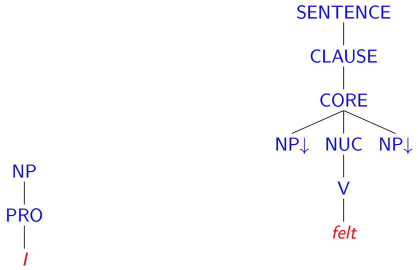
- ⋆ Such RRG grammars capture long-distance dependencies
  → for example, WH-movement.

Combination operations: Substitution and sister adjunction



Sentence: *I have felt many aftershocks*

Combination operations: Substitution and sister adjunction



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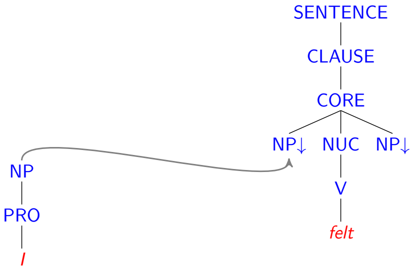

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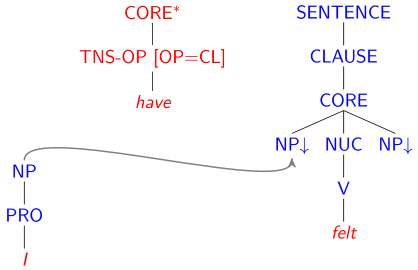

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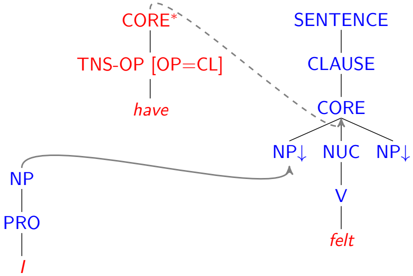

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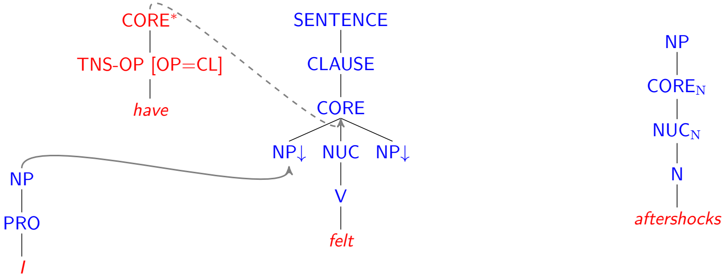

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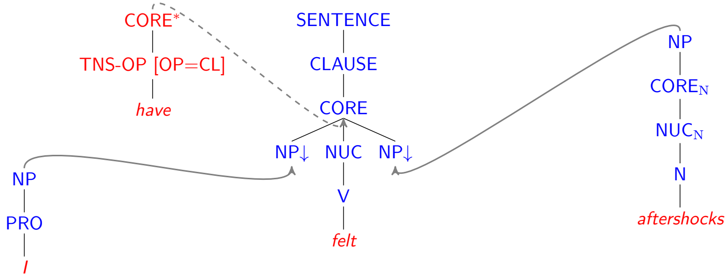

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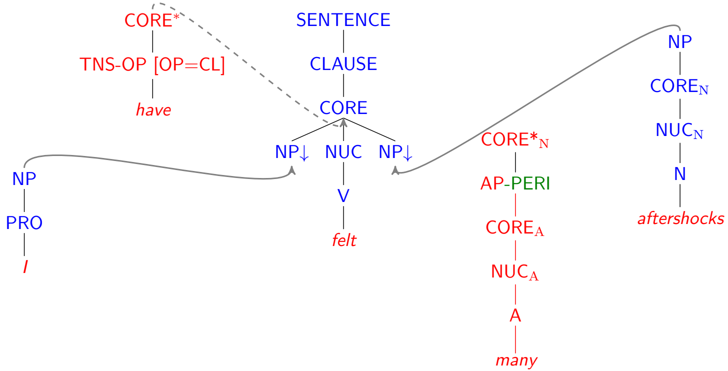

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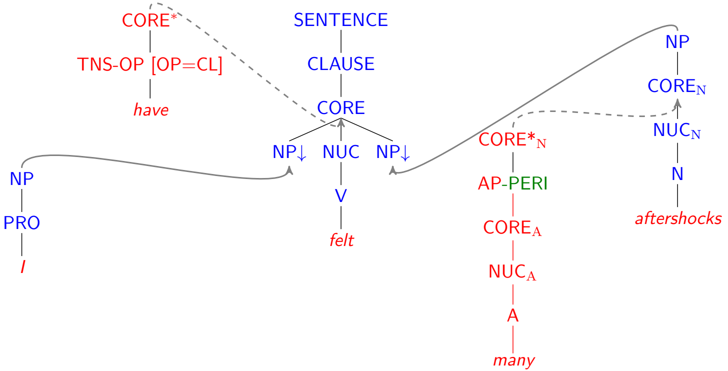

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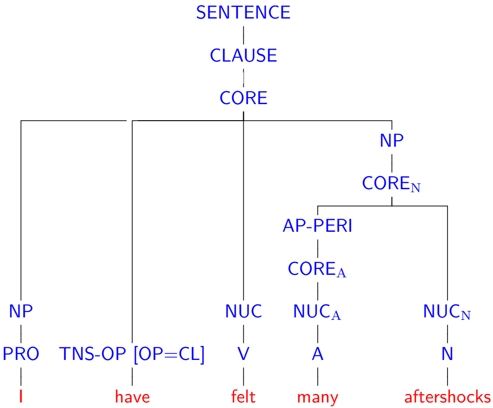

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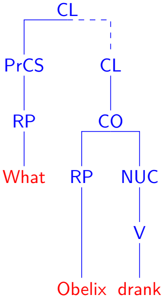
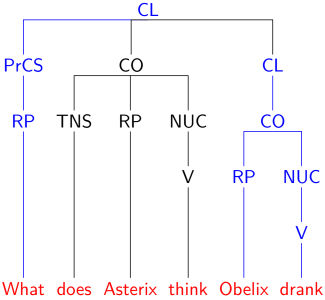
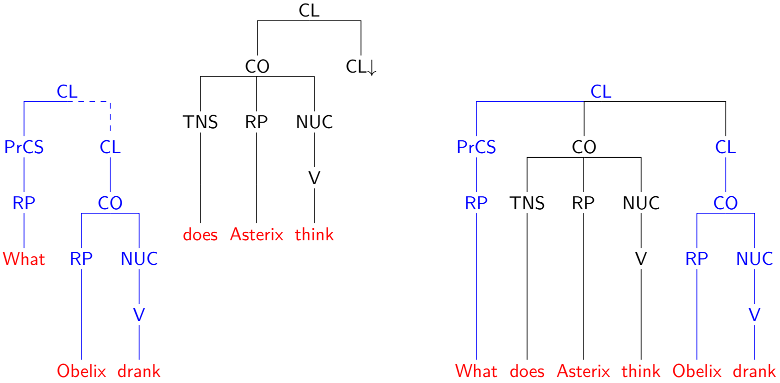
Combination operations: Wrapping substitution





Sentence: *What does Asterix think Obelix drank*

Combination operations: Wrapping substitution



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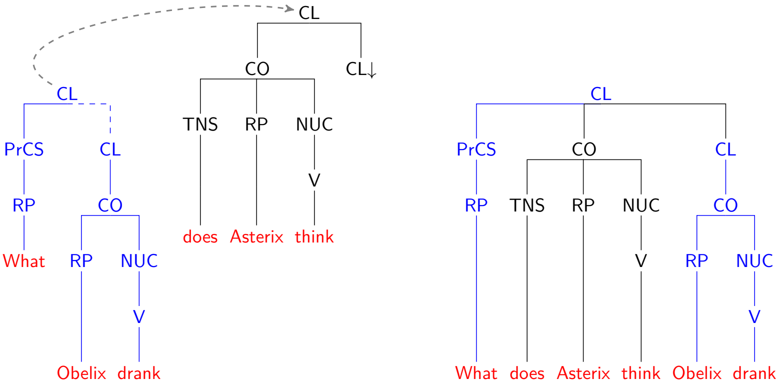

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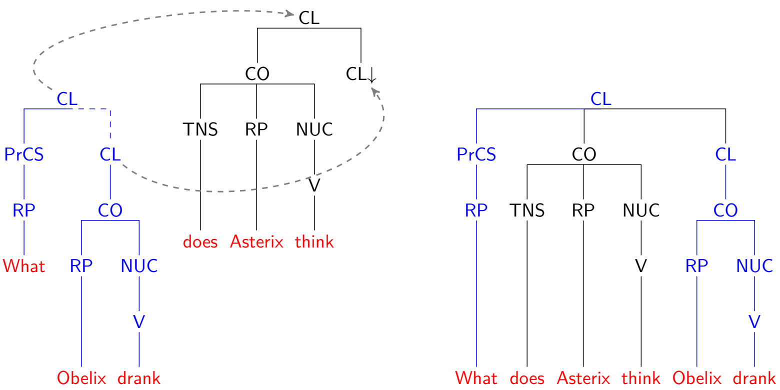

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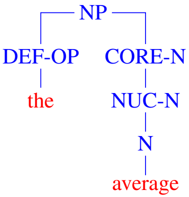
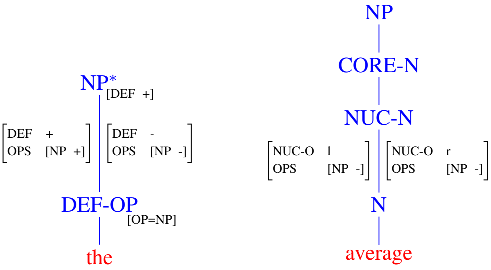
Elementary trees with features

RRGbank



Extracted Elementary Trees



- ⋆ elementary trees are enhanced with features

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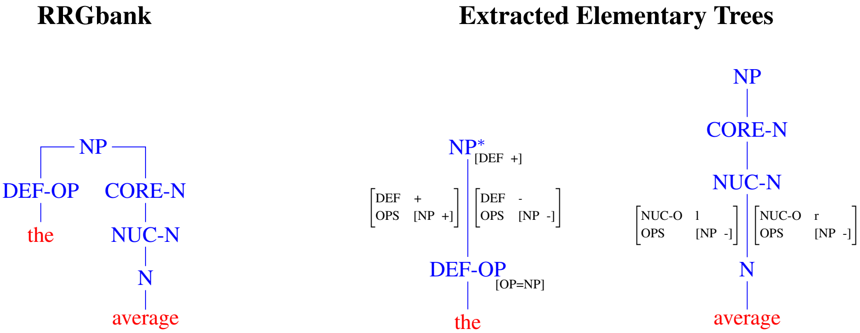

- ⋆ elementary trees are enhanced with features
  → edge features

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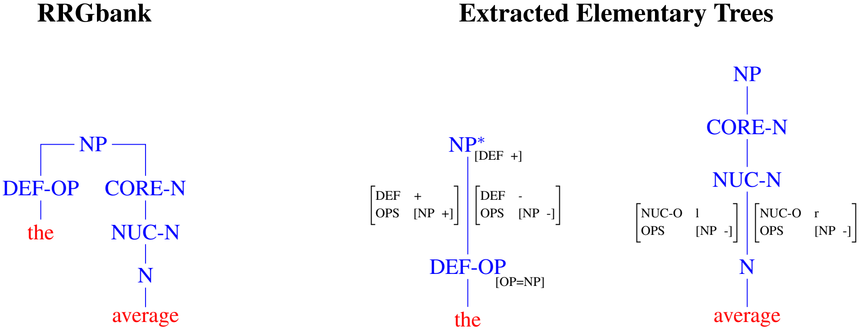
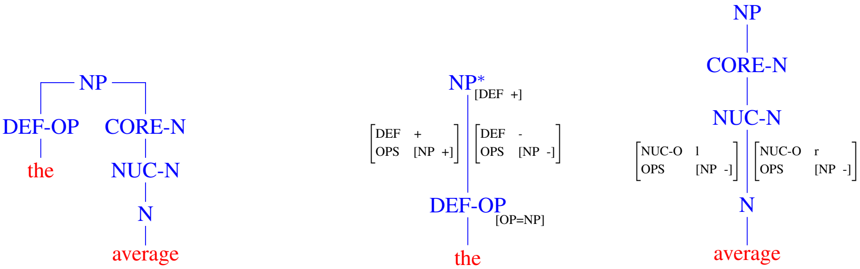


- ⋆ elementary trees are enhanced with features
  - → edge features
  - → node features

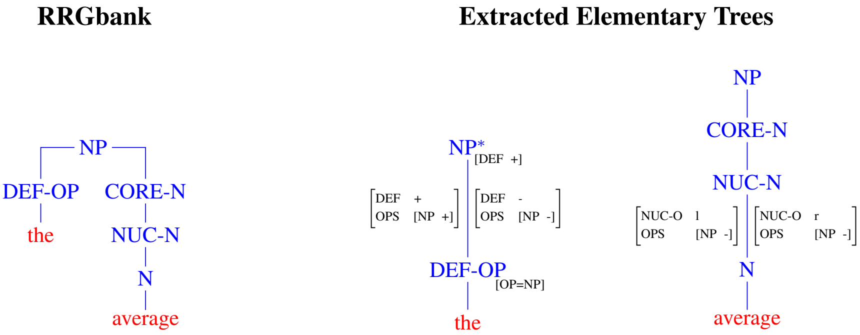
Edge features

RRGbank **Extracted Elementary Trees**



Left and right edge feature structures:

Edge features



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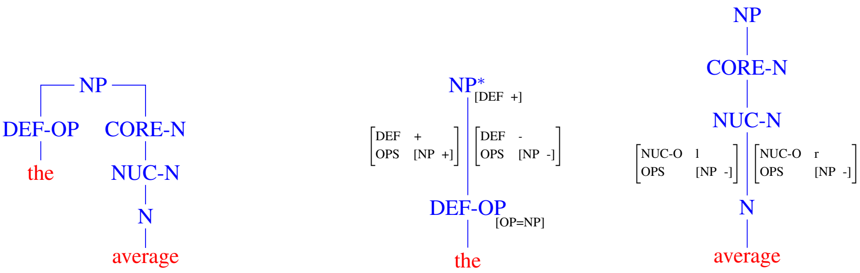

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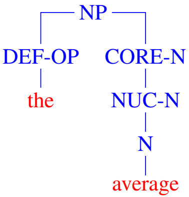

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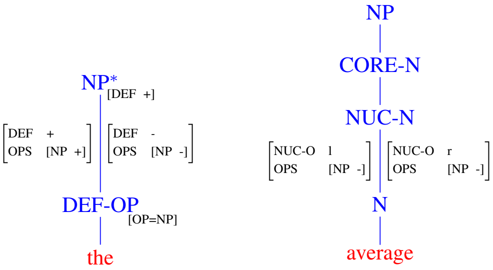
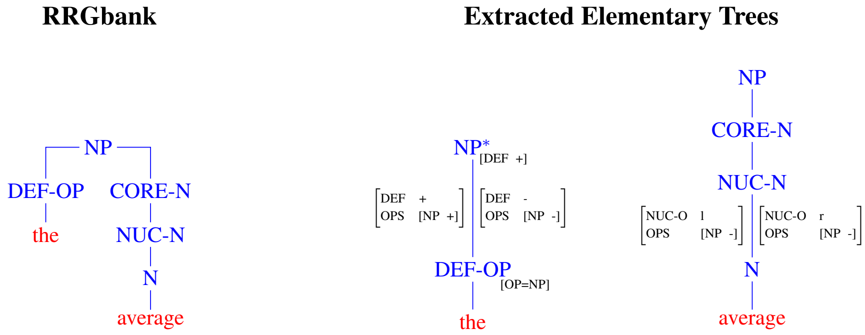


Left and right edge feature structures:

- ⋆ unify adjacent structures in the derived tree
- ⋆ model ordering constraints
- ⋆ percolate upwards until phrasal nodes

Node features



⋆ **One feature structure per node:**

- unify during tree composition
- store syntactic or syn-sem interface information.

⋆ Unification successful → accept parse tree

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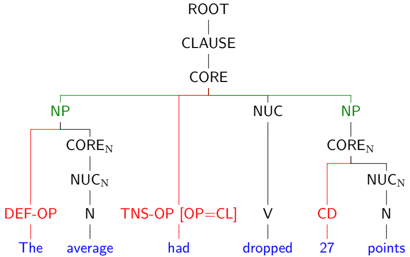
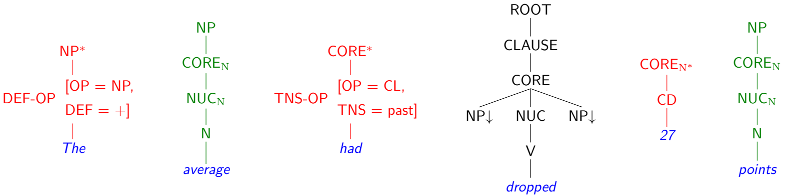
RRG Grammar extraction algorithm (1)

- ⋆ Elementary tree extraction inspired by Xia [6] algorithm for induction of Tree-Adjoining Grammars.
- ⋆ Top-down extraction of elementary trees.
- ⋆ Heuristics from head-modifier percolation tables.
- ⋆ We use RRG structures from RRGbank for automatic grammar induction
  → `rrgbank.phil.hhu.de`.

RRG Grammar extraction algorithm (2)





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- ⋆ suitable for hand-crafted precision RRG grammars;
- ⋆ suitable for automatically extracted RRG grammars.

Extracted RRG grammar

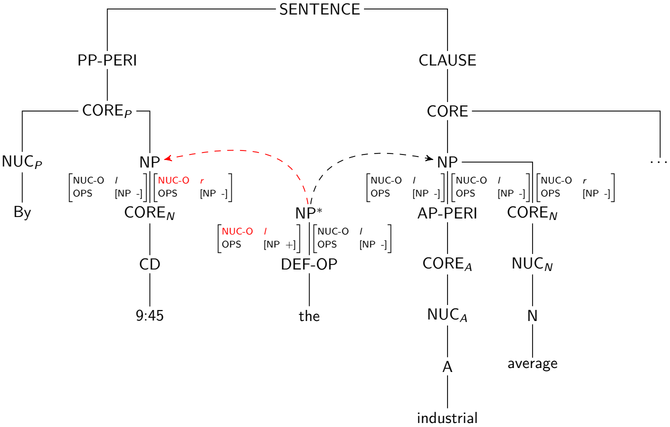
- removed punctuation
- exhaustive parsing (i.e. not probabilistic, overgenerating a lot)
- 2 versions:
  1. no features
  2. edge features for operators model adjunction constraints
- do feature structures eliminate parse trees that contradict linguistic intuitions?

Parsing experiments

	Gold Grammar		Silver Grammar	
	w feats	w/o feats	w feats	w/o feats
Sentences	395		1480	
avg. sentence length	6.1		8.0	
token-supertag pairs	1526	1497	6288	6044
avg. number of parses	6.9	12.7	1166	2939
savings	45.1%		39.7%	

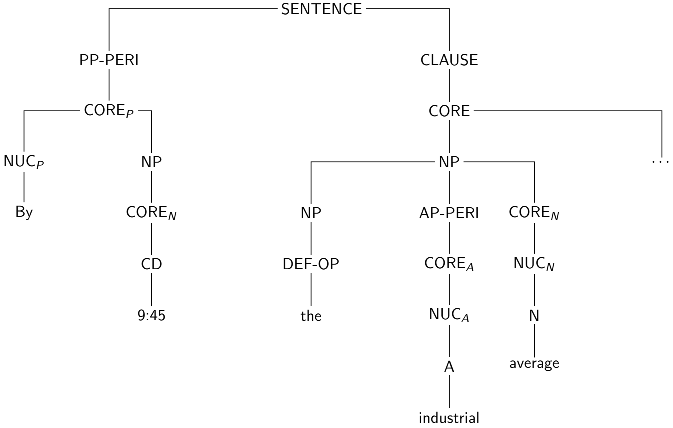
features decrease number of results by ≈ 45%

Features restrict adjunction of operators and periphery (1)



Sentence: *By 9:45, the industrial average had dropped 27 points.*

Features restrict adjunction of operators and periphery (2)



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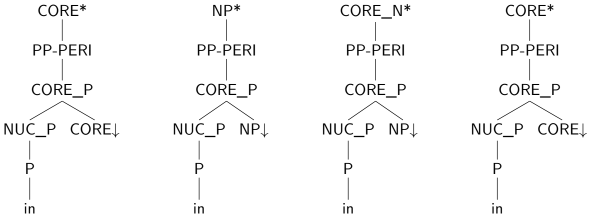
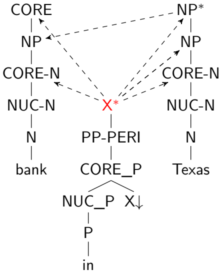
Attachment ambiguities





syntactic information needed that might not be in RRGBank

Size of the grammar

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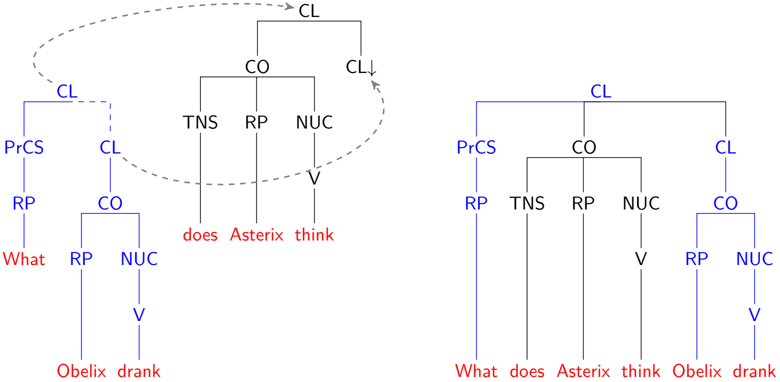
the number of parses per sentence increases with the size of the grammar

Extraction of wrapping substitution trees



- ⋆ discontinuous constituents are marked with traces in PTB;
- ⋆ no special marking in RRGBank;
- ⋆ transfer traces from PTB to RRG trees in RRGbank?

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- ⋆ automatically extracted elementary trees from RRGBank;
- ⋆ experiments with exhaustive parsing of 395/1480 sentences;
- ⋆ parsing w/o edge features → too many results;
- ⋆ some edge features already rule out bad results.

Future Work

- ⋆ adding more edge features = better results;
- ⋆ extract wrapping elementary trees;
- ⋆ 100s of results → not satisfying;
- ⋆ ambiguity and annotation/extraction mistakes have bad consequences;
- ⋆ use unlexicalized elementary trees (= supertags);
- ⋆ probabilistic grammar and parsing
  → A* parsing algorithm ParTAGe by Waszczuk (2017) [5];
- ⋆ Web GUI.

Thank you!

THANK YOU VERY MUCH FOR YOUR ATTENTION!

References I

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