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

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Agenda

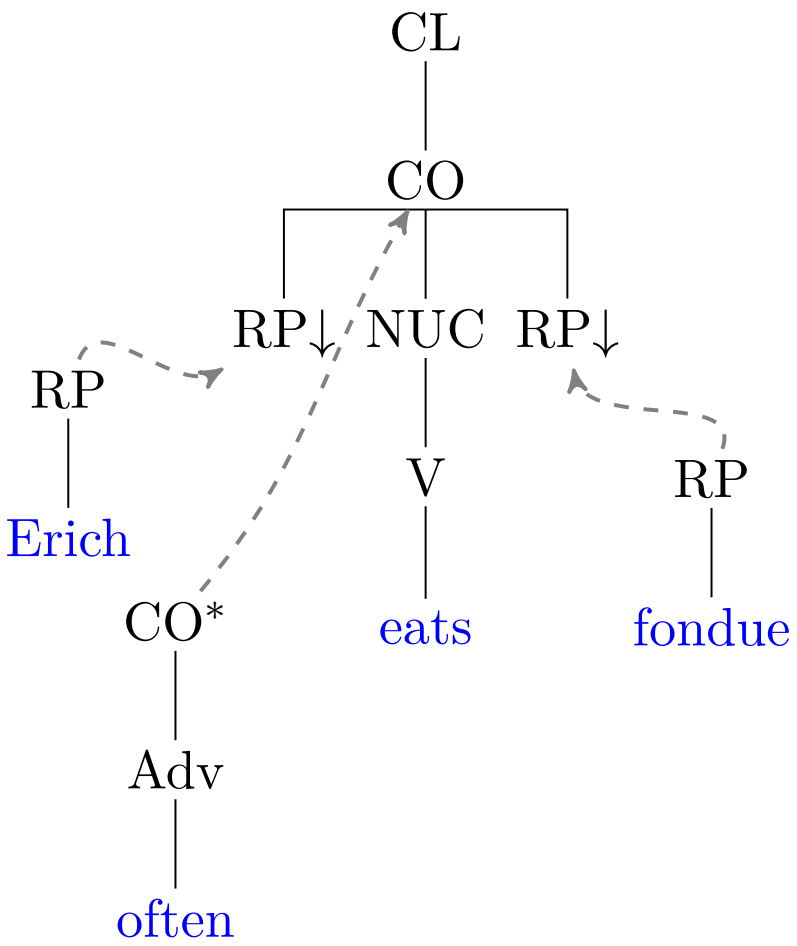
- ⋆ Chart-based bottom-up parser in CYK-style for RRG grammars
  → hand-crafted & automatically extracted RRG grammars;
  → features on elementary trees are used to improve the performance of the parser.

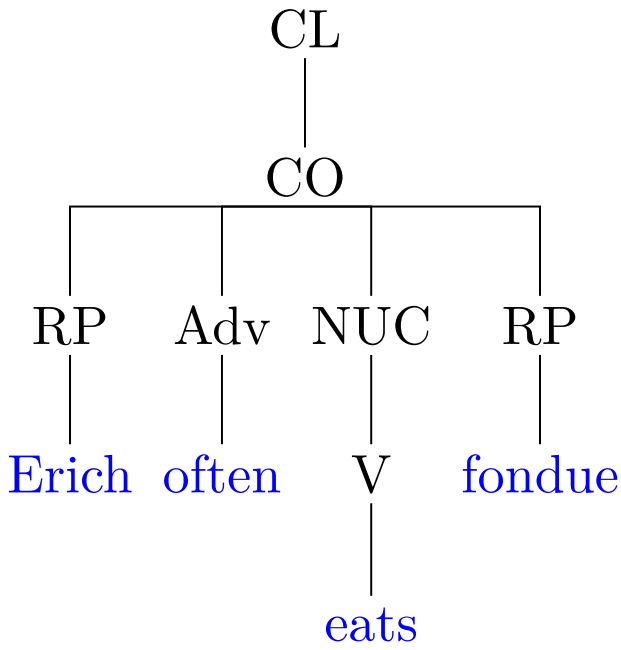
- ⋆ **Today we are presenting:**
  → Design of RRG grammars.
  → Elementary trees with features and combination operations.
  → Automatic extraction of the elementary trees (≈ supertags) from RRGbank.
  → Parsing experiments with the automatically extracted RRG grammar.

Elementary trees in RRG Grammars

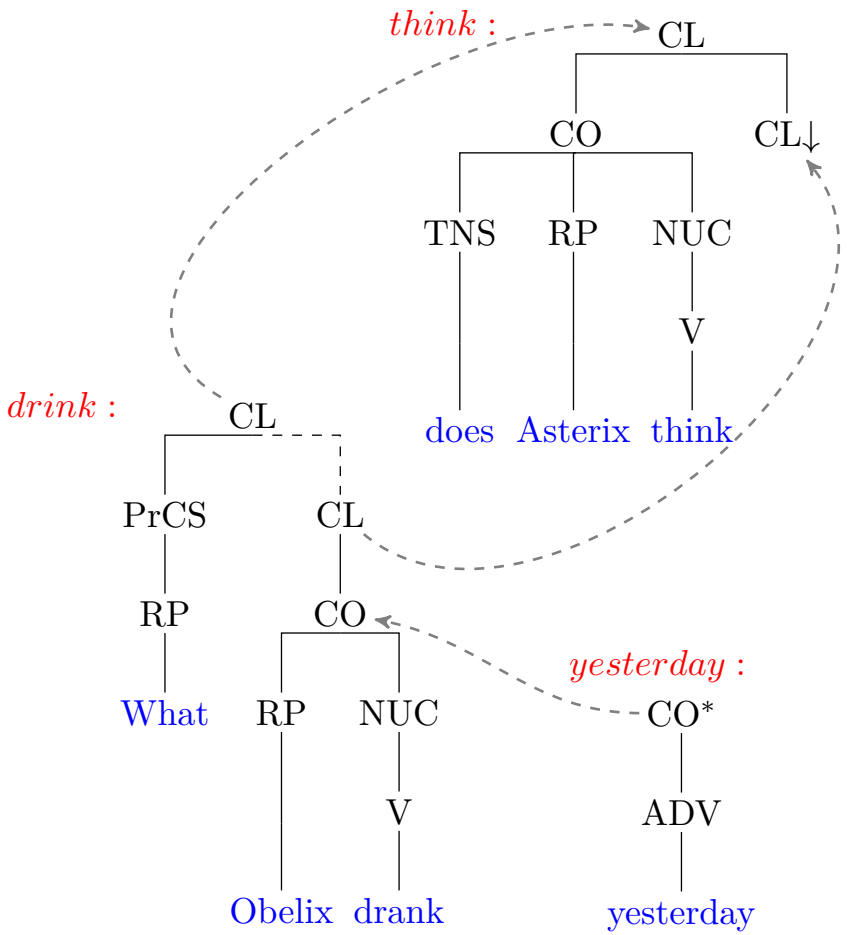
- We follow Kallmeyer et al. (2013); Osswald and Kallmeyer (2018) in design of the elementary trees in our grammar.
- Three tree composition operations:
  → *substitution* (for argument slot filling)
  → *wrapping substitution* (for argument slot filling combined with "extraction")
  → *sister adjunction* (for adding operators and periphery elements among others).

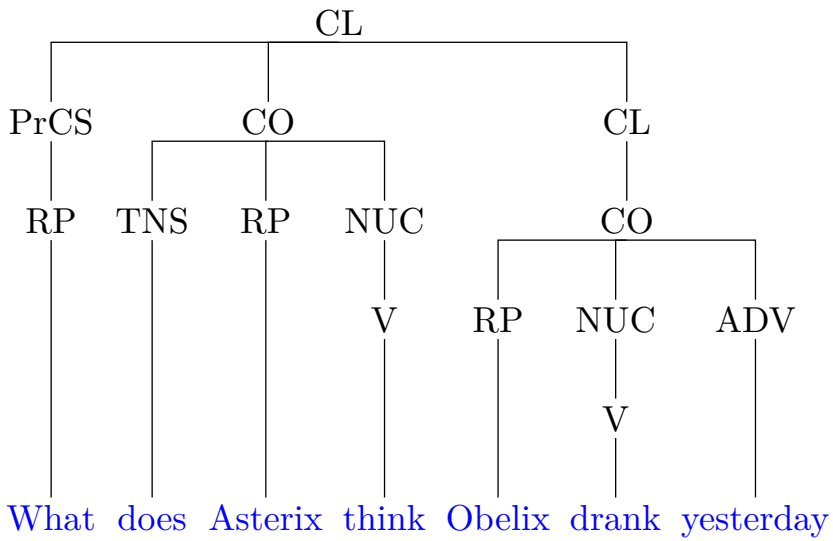
Combination operations: Substitution and sister adjunction





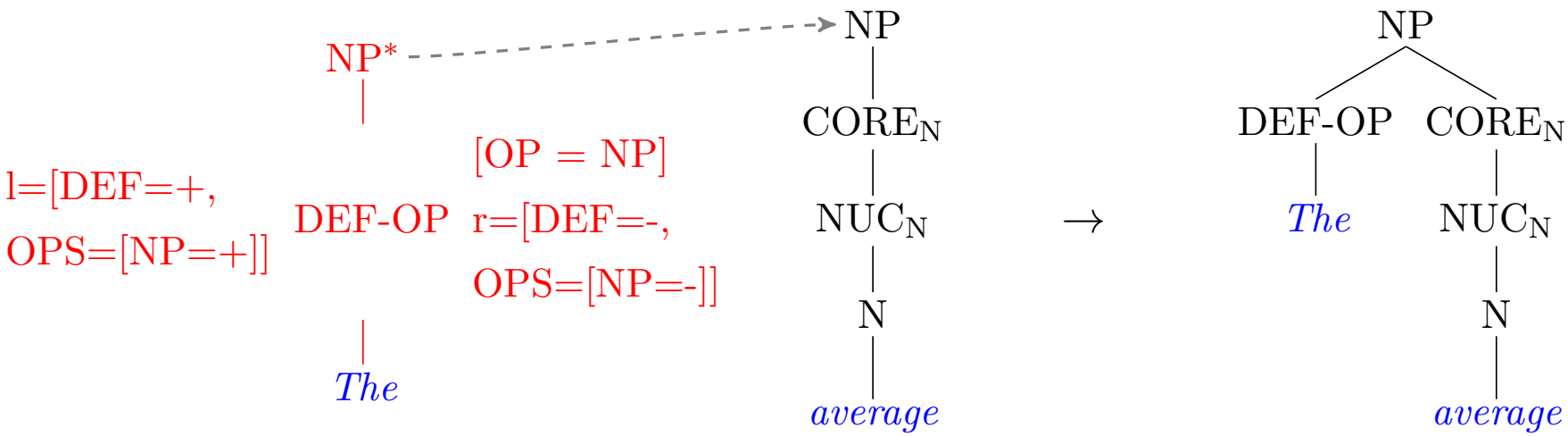
Combination operations: Wrapping substitution





Elementary trees with features

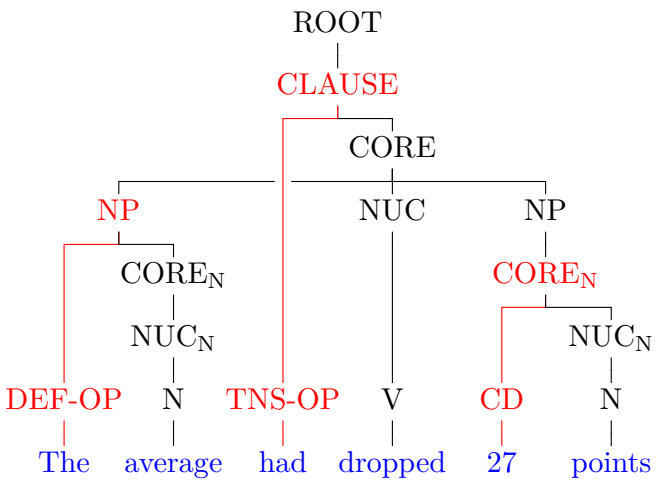
- ⋆ **Edge features:** Left and right edge features are used to model adjunction constraints during parsing.
- ⋆ **Node features:** Nodes have just a single feature structure. Node features are used to store and share syntactic or semantic information.
- ⋆ Such RRG grammars capture long-distance dependencies.

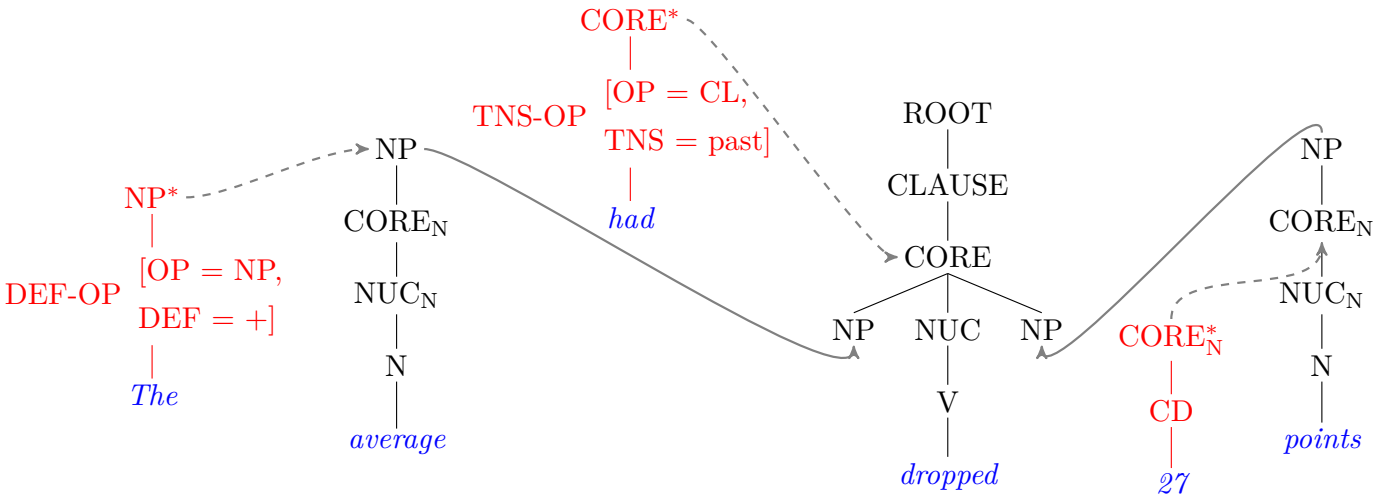


RRG Grammar extraction algorithm (1)

- ⋆ Elementary tree extraction inspired by Xia (1999) algorithm for LTAG induction.
- ⋆ Top-down extraction using heuristics from head-modifier percolation tables.
- ⋆ We use RRG structures from RRGbank for grammar induction
  → corpus of derivation structures automatically converted to RRG from the Penn Treebank (Bladier et al., 2018);
  → `rrgbank.phil.hhu.de`.
- ⋆ We decided to reattach some nodes in the RRG structures before extraction to avoid crossing branches
  → we use a node feature which indicates the correct placement of these nodes.

RRG Grammar extraction algorithm (2)





The grammar I

- source: 300 sentences from RRGBank
- ≈ 2500 lexicalized elementary trees for 1911 lexical items
- 1150 auxiliary trees
  - ADV, CLM, AUX, some nouns
- one sentence with wrapping
- removed punctuation

The grammar II

- 2 versions:
  1. no features
  2. edge features for operators model adjunction constraints
- Why extract features? all the information is in RRGBank!

- Do features improve performance?
  - How much?
  - How?

Parsing experiments I

- Parse 240 of 300 sentences we extracted the elementary trees from
- features decrease number of results by $\approx 40\%$
- w/o features: $>$ 20000 parses for some sentences (average 866)
- w features: 8200 at most (average 550)
  $\rightarrow$ still too much

Parsing experiments II

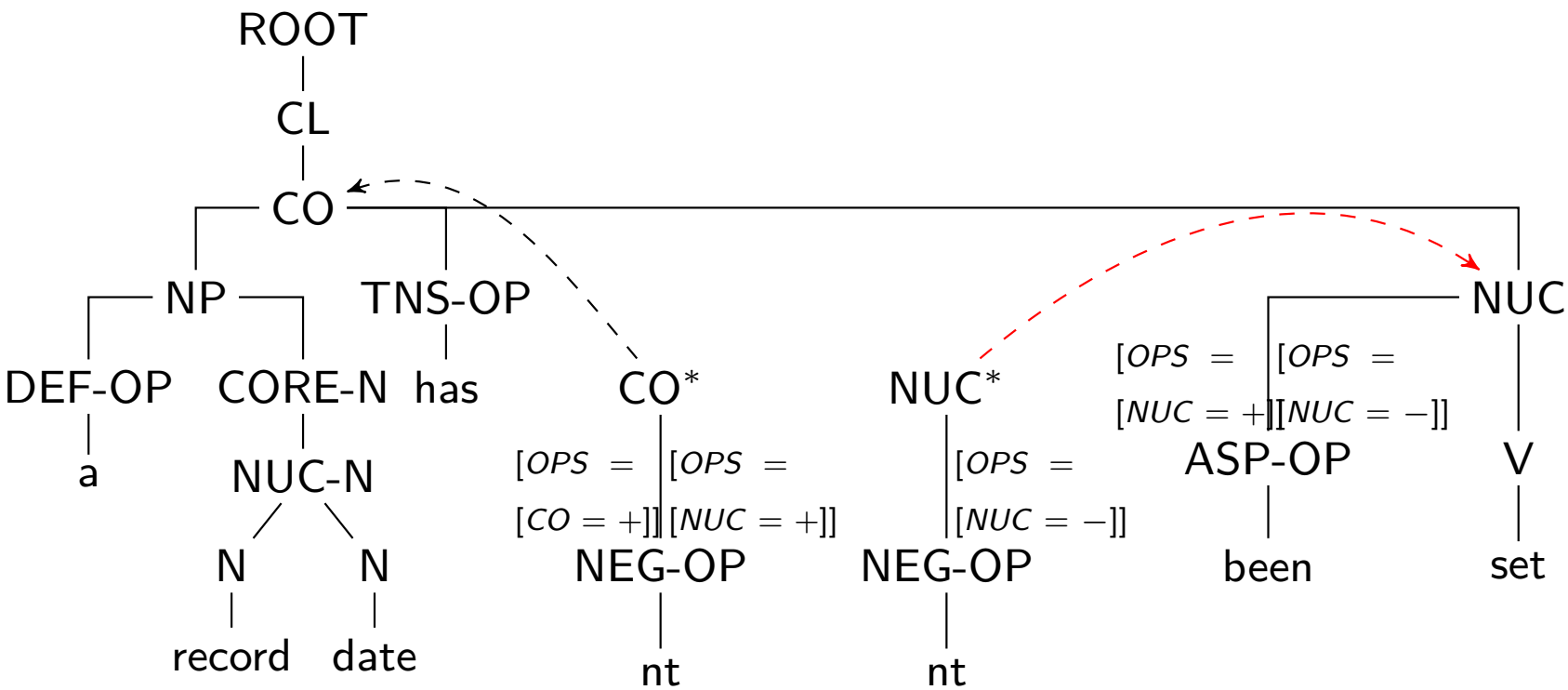
What's the problem?

- too many trees for frequent lexical items
- prepositions, articles and CLMs adjoin at different layers
- about 10 trees each for prepositions like *to*, *for*, *in*

Can this be solved by features? Sometimes

What is currently done I

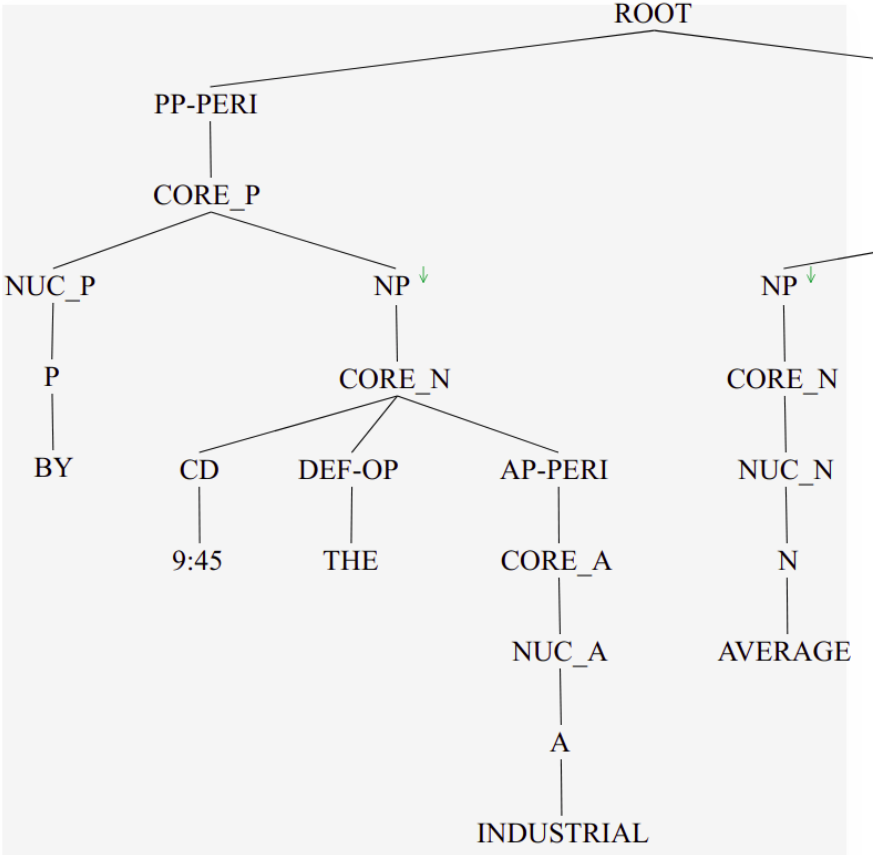
A record date hasn't been set



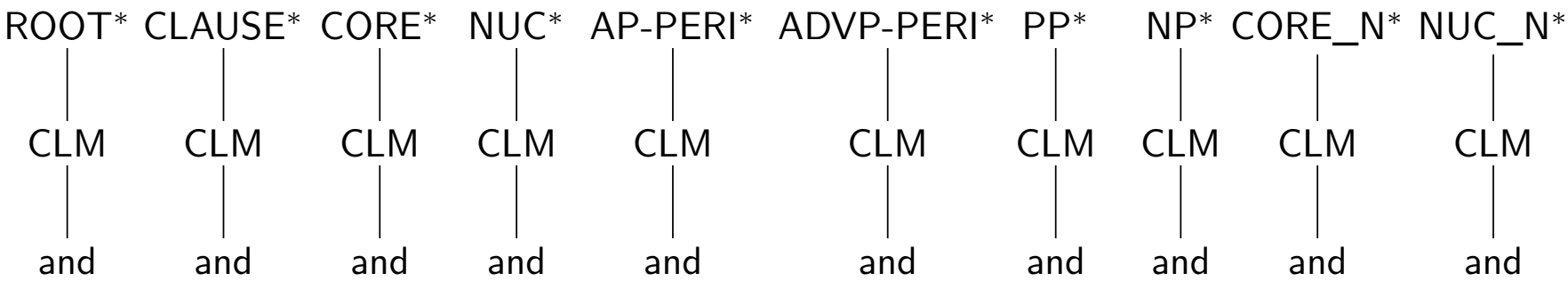
What can (and will) be done

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

- Some operator features at anchors are still missing
- peripheral adjunction constraints

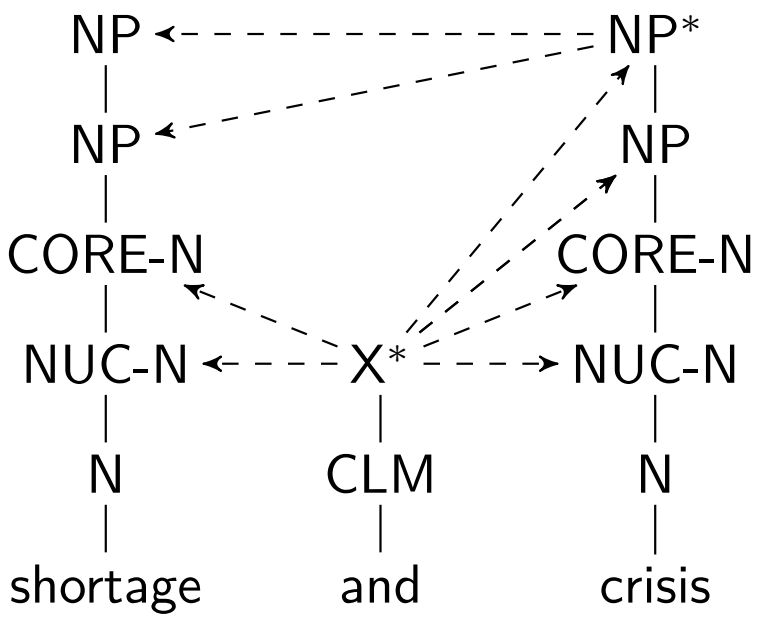


What maybe can not be done I



syntactic information needed that might not be in RRGBank

What maybe can not be done II



→ 13 results

Summary

- automatically extracted elementary trees from hand-crafted RRGBank
- experiments with exhaustive parsing of 240 sentences
- parsing w/o edge features $\rightarrow$ too many results
- some edge features already rule out bad results
- plan for the future: more edge features = better results

Performance

Necessity of probabilistic parsing

- 100s of results → not satisfying
- ambiguity and a few annotation/extraction mistakes have bad consequences
- Possible solution: probabilistic grammar and parsing

Outlook TuLiPA & RRG

- edge feature unification happens as last step of processing
  $\rightarrow$ expensive
- integration in the chart parsing algo will help

- layered lexicon and anchoring
- (Web)GUI?
- A* parsing

Thank you!

THANK YOU VERY MUCH FOR YOUR ATTENTION!

References I

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