The Return of Unlexicalized PCFGs

Accurate Unlexicalized Parsing

[Klein and Manning 1993]

- What do we mean by an "unlexicalized" PCFG?
  - Grammar rules are not systematically specified down to the level of lexical items
    - NP-stocks is not allowed
    - NP^S-CC is fine
  - Closed vs. open class words
    - Long tradition in linguistics of using function words as features or markers for selection (VB-have, SBAR-if/whether)
    - Different to the bilexical idea of semantic heads
    - Open-class selection is really a proxy for semantics
- Thesis
  - Most of what you need for accurate parsing, and much of what lexicalized PCFGs actually capture *isn't* lexical selection between content words but just basic grammatical features, like verb form, finiteness, presence of a verbal auxiliary, etc.

Experimental Approach

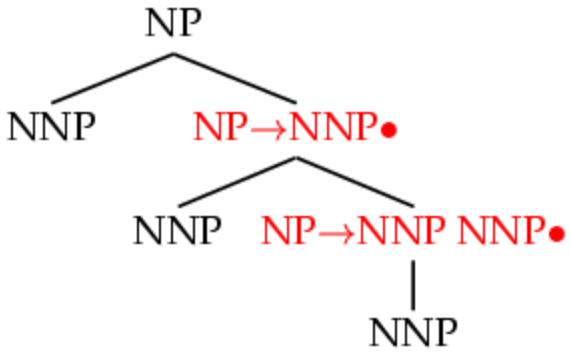
- Corpus: Penn Treebank, WSJ; iterate on small dev set

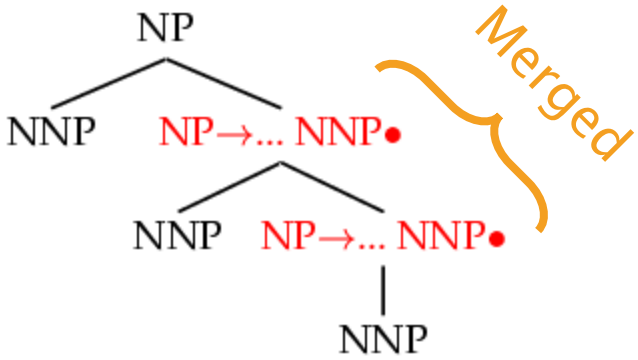
Training:	sections	02-21
Development:	section	22 (first 20 files) ←
Test:	section	23

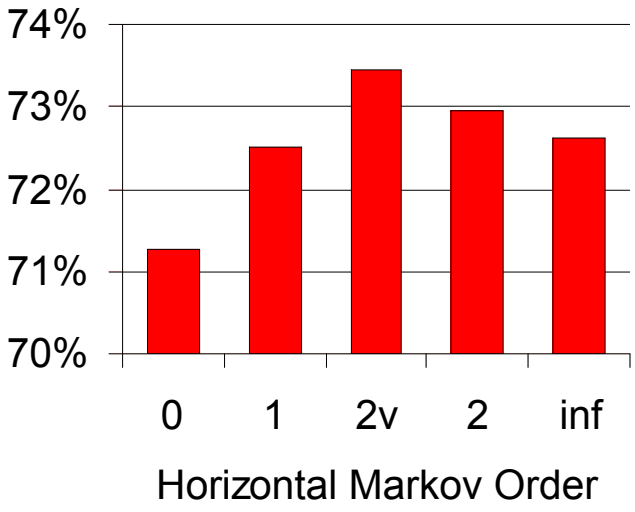
- Size – number of symbols in grammar.
  - Passive / complete symbols: NP, NP^S
  - Active / incomplete symbols: @NP_NP_CC [from binarization]
- We state-split as sparingly as possible
  - Highest accuracy with fewest symbols
  - Error-driven, manual hill-climb, one annotation at a time

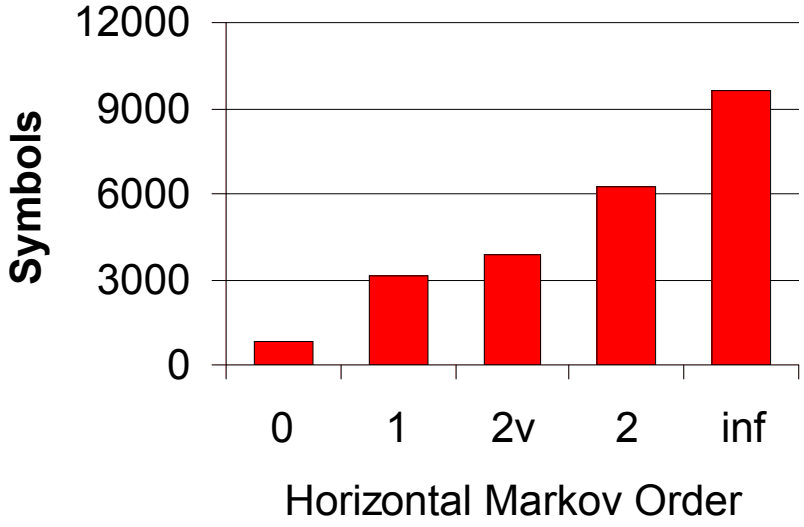
Horizontal Markovization

- Horizontal Markovization: Merges States







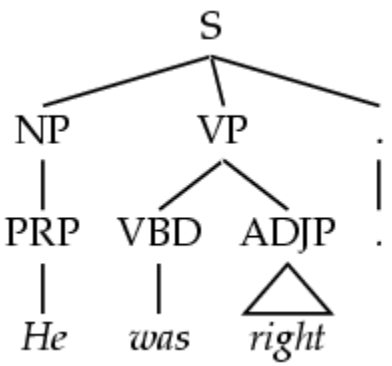


Vertical Markovization

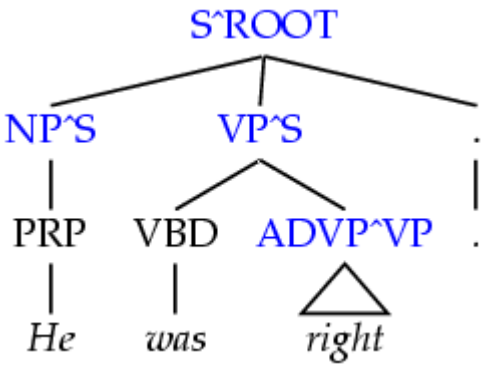
- Vertical Markov order: rewrites depend on past *k* ancestor nodes.

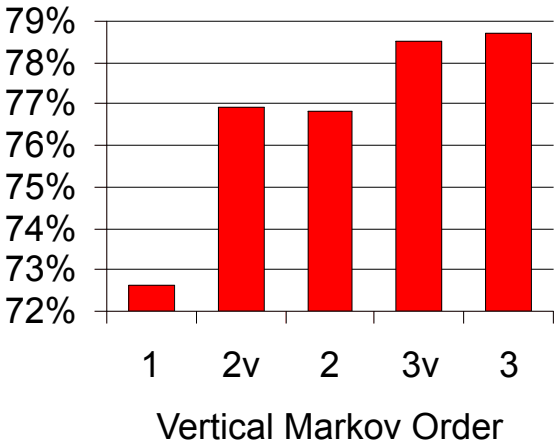
  (i.e., parent annotation)

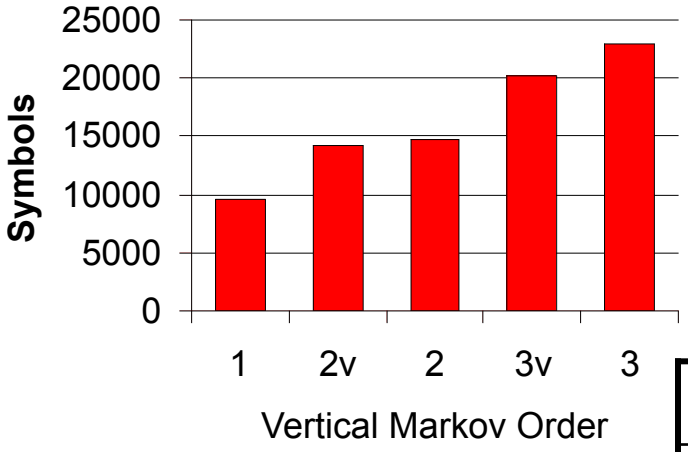
Order 1



Order 2



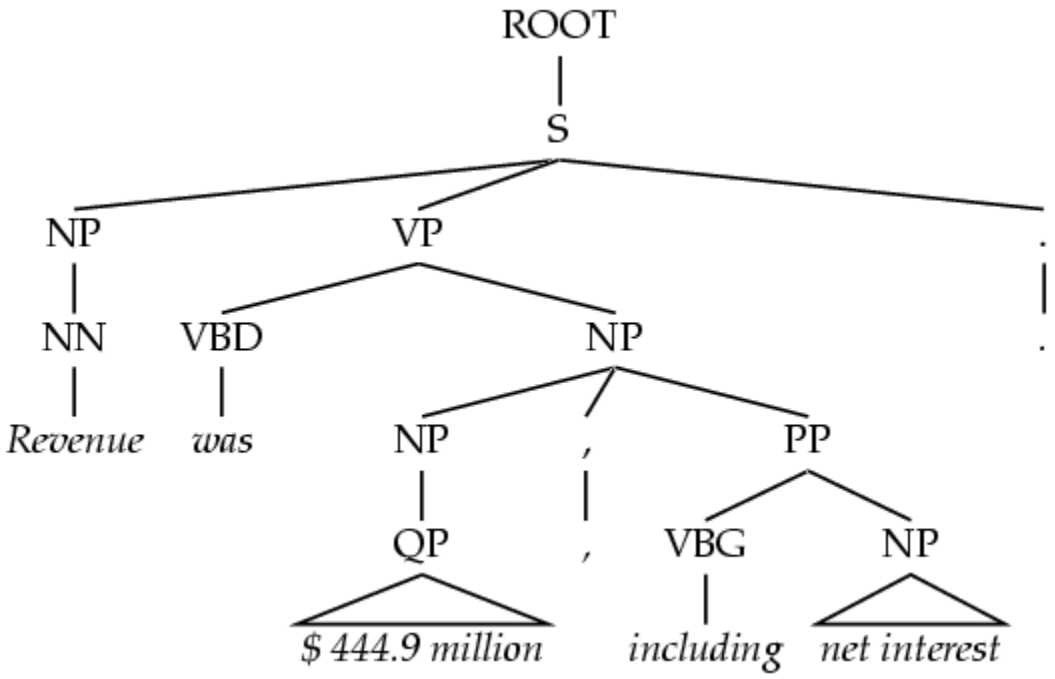




Model	F1	Size
v=h=2v	77.8	7.5K

Unary Splits

- Problem: unary rewrites are used to transmute categories so a high-probability rule can be used.

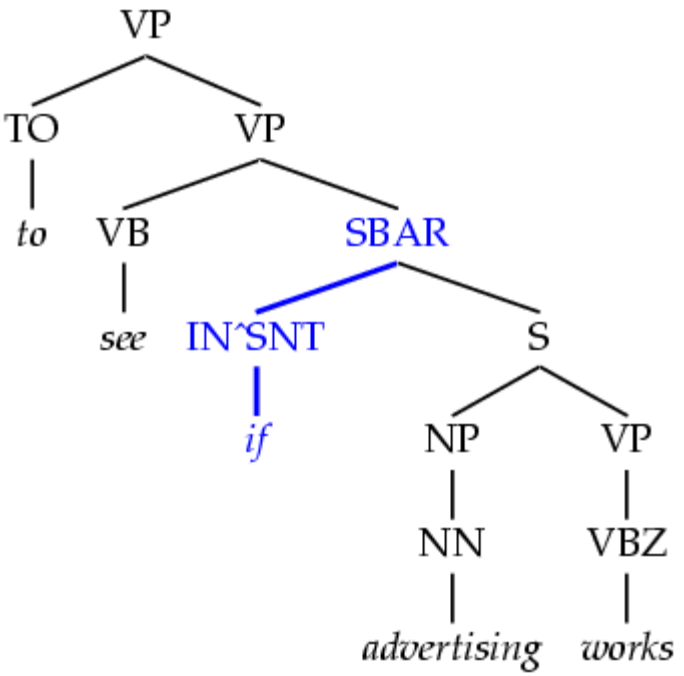


- Solution: Mark unary rewrite sites with -U

Annotation	F1	Size
Base	77.8	7.5K
UNARY	78.3	8.0K

Tag Splits

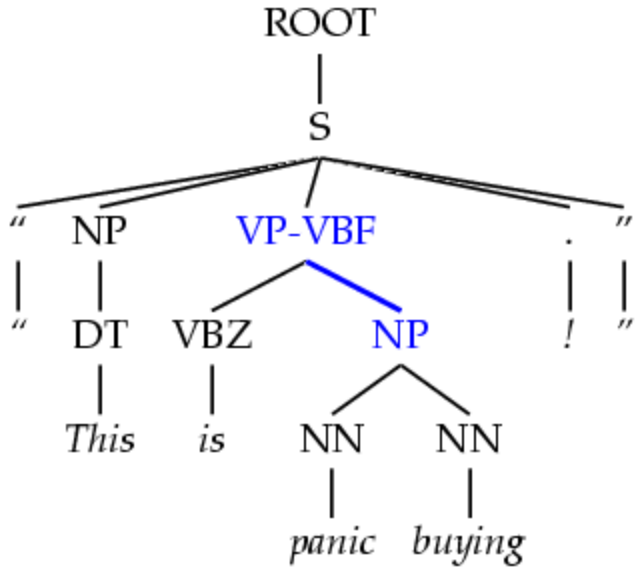
- Problem: Treebank tags are too coarse.
- Example: SBAR sentential complementizers (*that, whether, if)*, subordinating conjunctions (*while, after)*, and true prepositions (*in, of, to)* are all tagged IN.
- Partial Solution:
  - Subdivide the IN tag.



Annotation	F1	Size
Previous	78.3	8.0K
SPLIT-IN	80.3	8.1K

Yield Splits

- Problem: sometimes the behavior of a category depends on something inside its future yield.
- Examples:
  - Possessive NPs
  - Finite vs. infinite VPs
  - Lexical heads!
- Solution: annotate future elements into nodes.

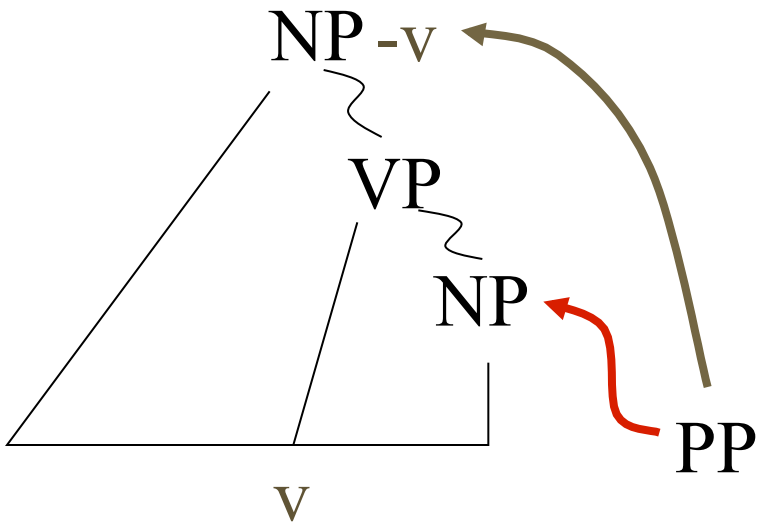


Annotation	F1	Size
tag splits	82.3	9.7K
POSS-NP	83.1	9.8K
SPLIT-VP	85.7	10.5K

Distance / Recursion Splits

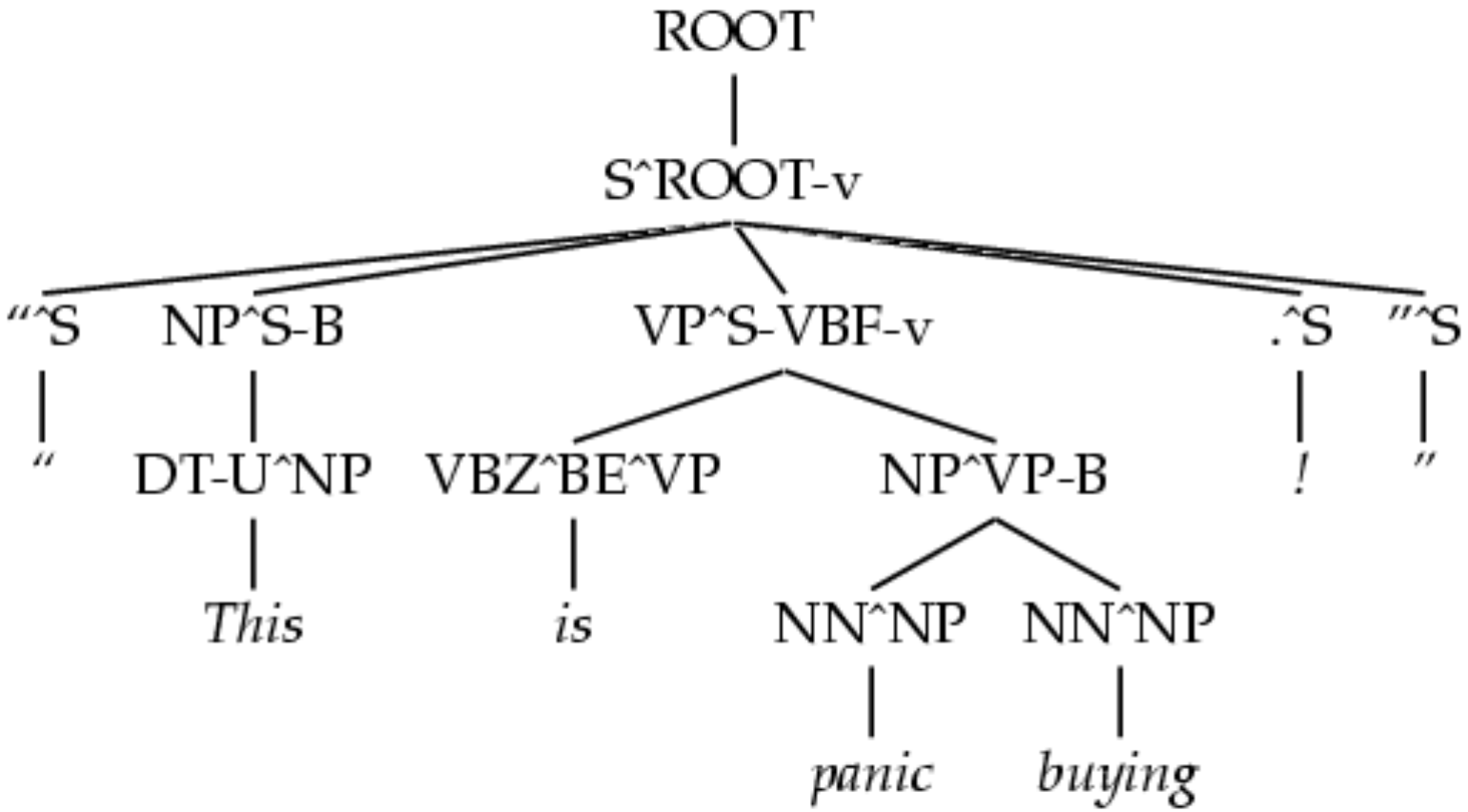
- Problem: vanilla PCFGs cannot distinguish attachment heights.

- Solution: mark a property of higher or lower sites:
  - Contains a verb.
  - Is (non)-recursive.
    - Base NPs [cf. Collins 99]
    - Right-recursive NPs



Annotation	F1	Size
Previous	85.7	10.5K
BASE-NP	86.0	11.7K
DOMINATES-V	86.9	14.1K
RIGHT-REC-NP	87.0	15.2K

A Fully Annotated Tree



Final Test Set Results

Parser	LP	LR	**F1**
Magerman 95	84.9	84.6	**84.7**
Collins 96	86.3	85.8	**86.0**
Klein & Manning 03	86.9	85.7	**86.3**
Charniak 97	87.4	87.5	**87.4**
Collins 99	88.7	88.6	**88.6**

- Beats "first generation" lexicalized parsers

The Return of Unlexicalized PCFGs