Parser Evaluation

Parser Evaluation

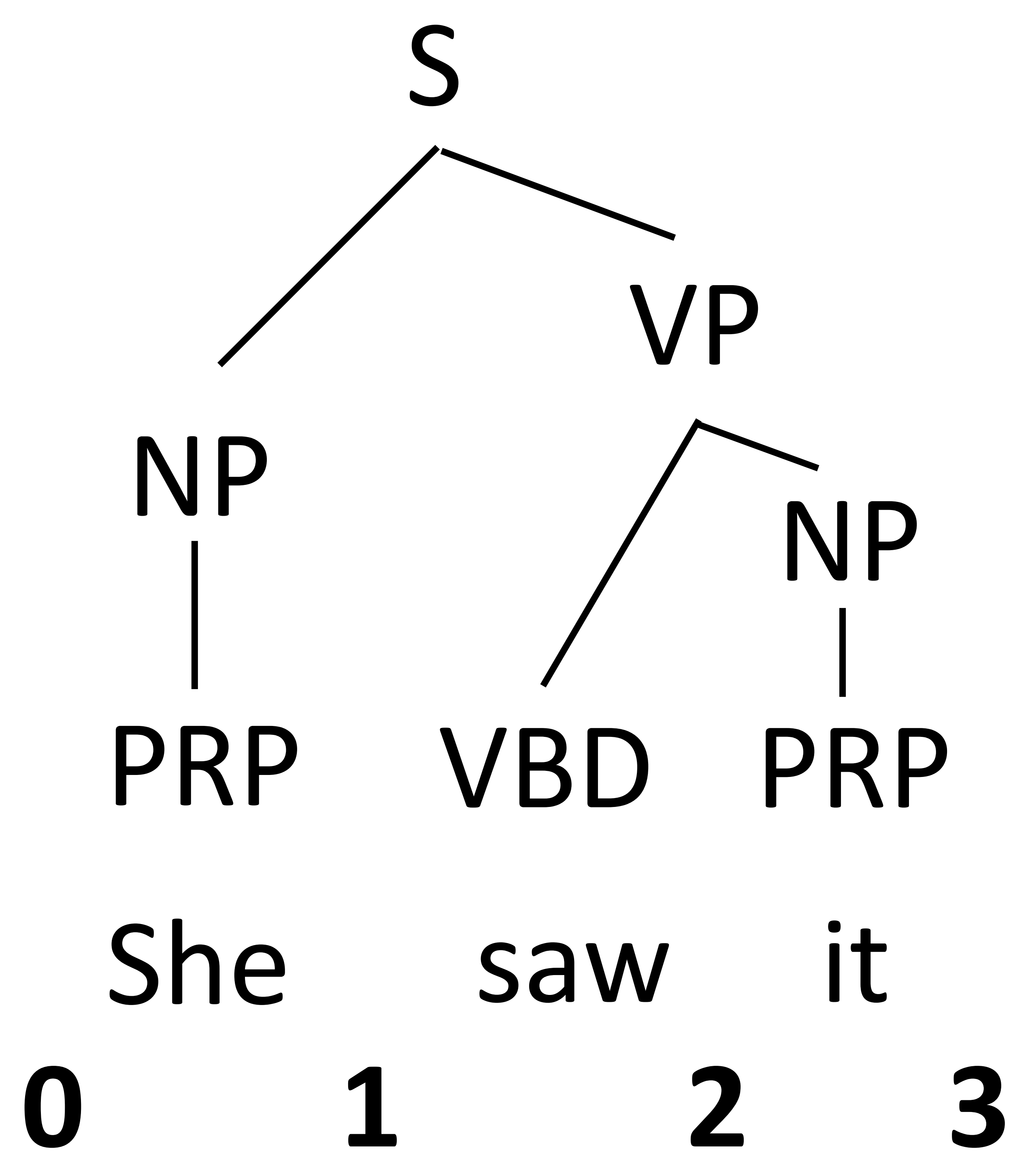
- View a parse as a set of labeled *brackets* / constituents

S(0,3)

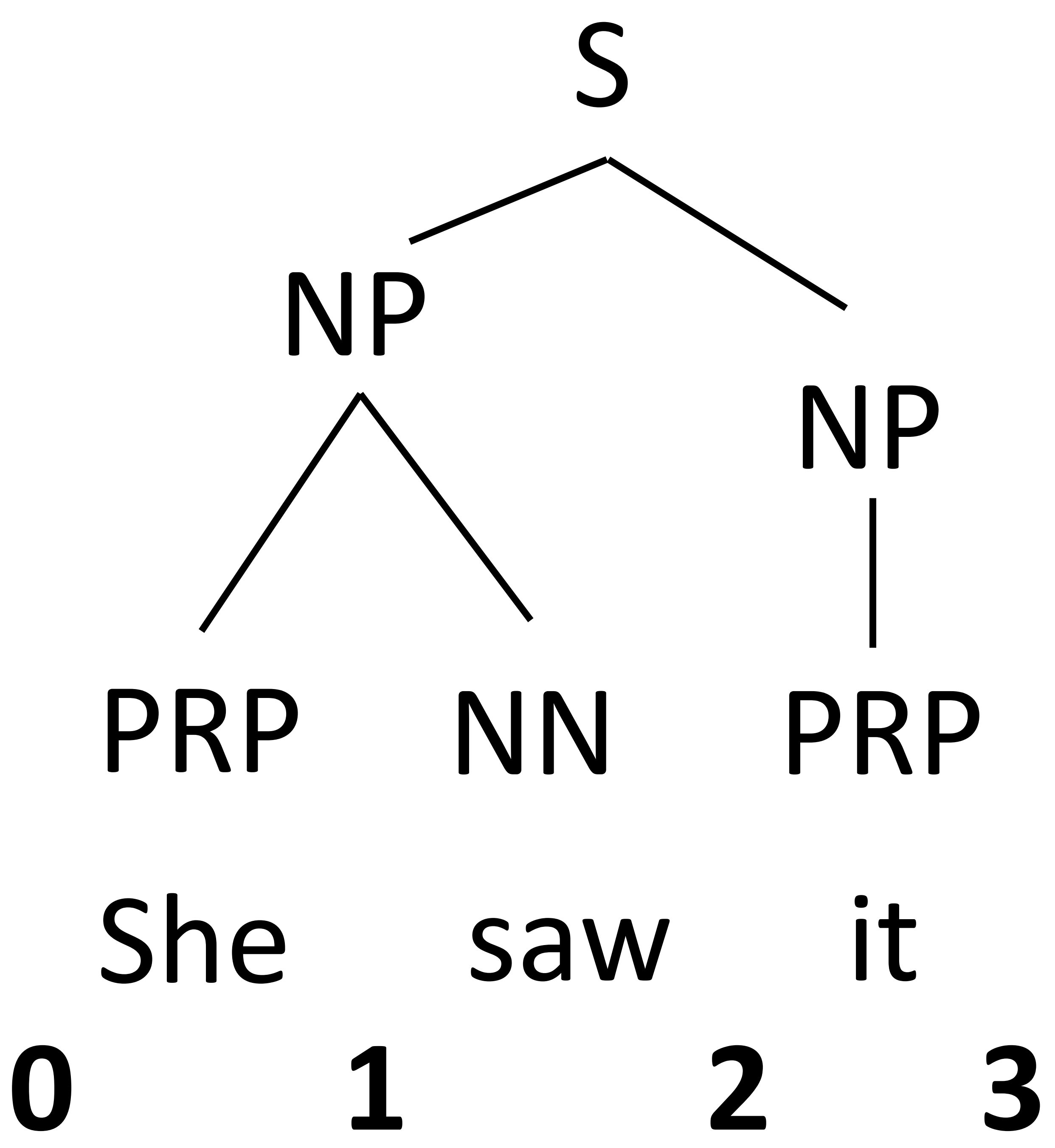
NP(0,1)

PRP(0,1) (but standard evaluation *does not count POS tags*)

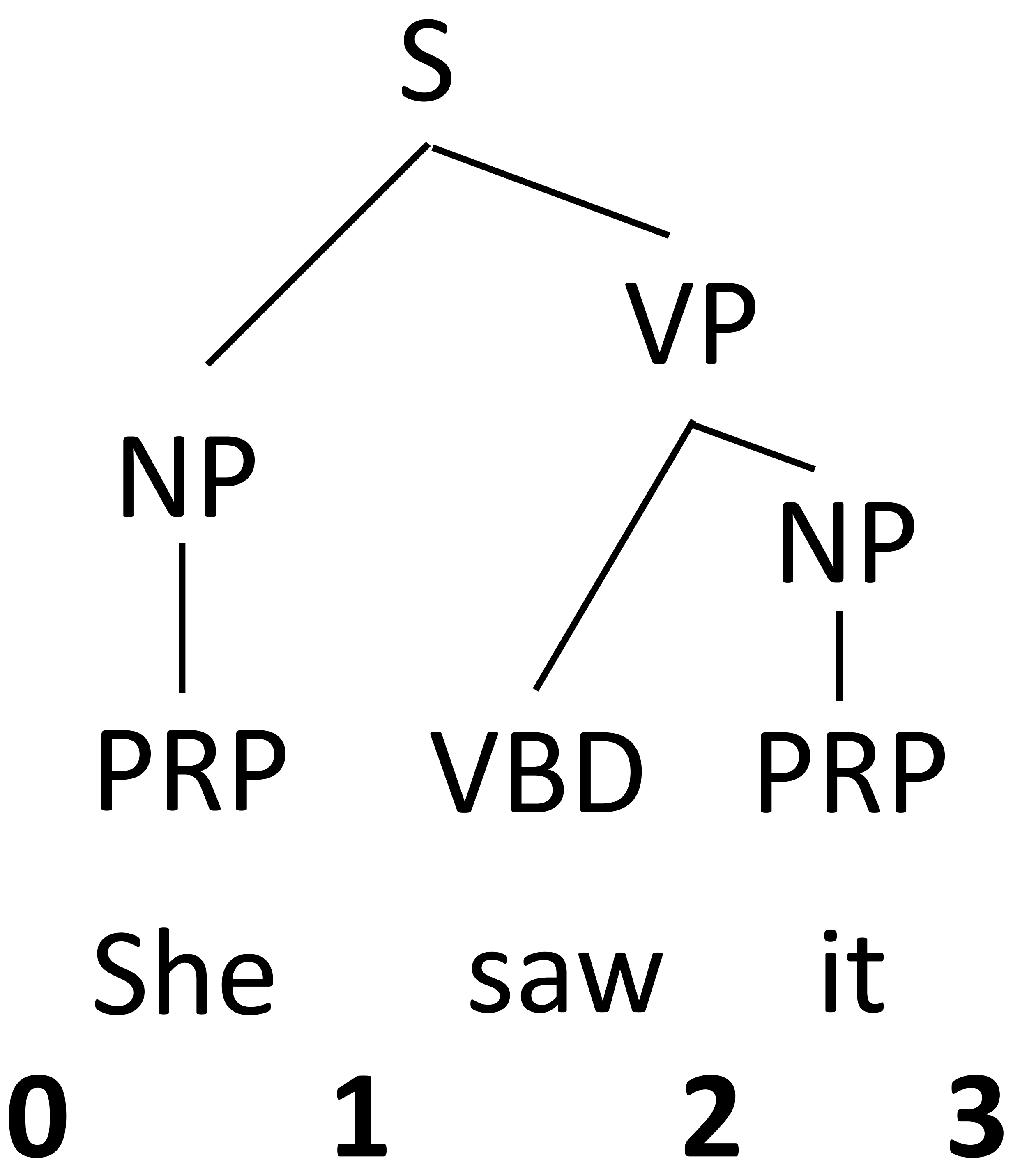
VP(1,3), VBD(1,2), NP(2,3), PRP(2,3)



Parser Evaluation



S(0,3),
NP(0,2),
NP(2,3),
~~PRP(0,1),~~
~~NN(1,2),~~
~~PRP(2,3)~~



S(0,3),
NP(0,1),
VP(1,3),
NP(2,3),
~~PRP(0,1),~~
~~VBD(1,2),~~
~~PRP(2,3)~~

- Precision: number of correct predictions / number of predictions = 2/3
- Recall: number of correct predictions / number of golds = 2/4
- F1: harmonic mean of precision and recall = $(1/2 * ((2/4)^{-1} + (2/3)^{-1}))^{-1}$

  = 0.57 (closer to min)

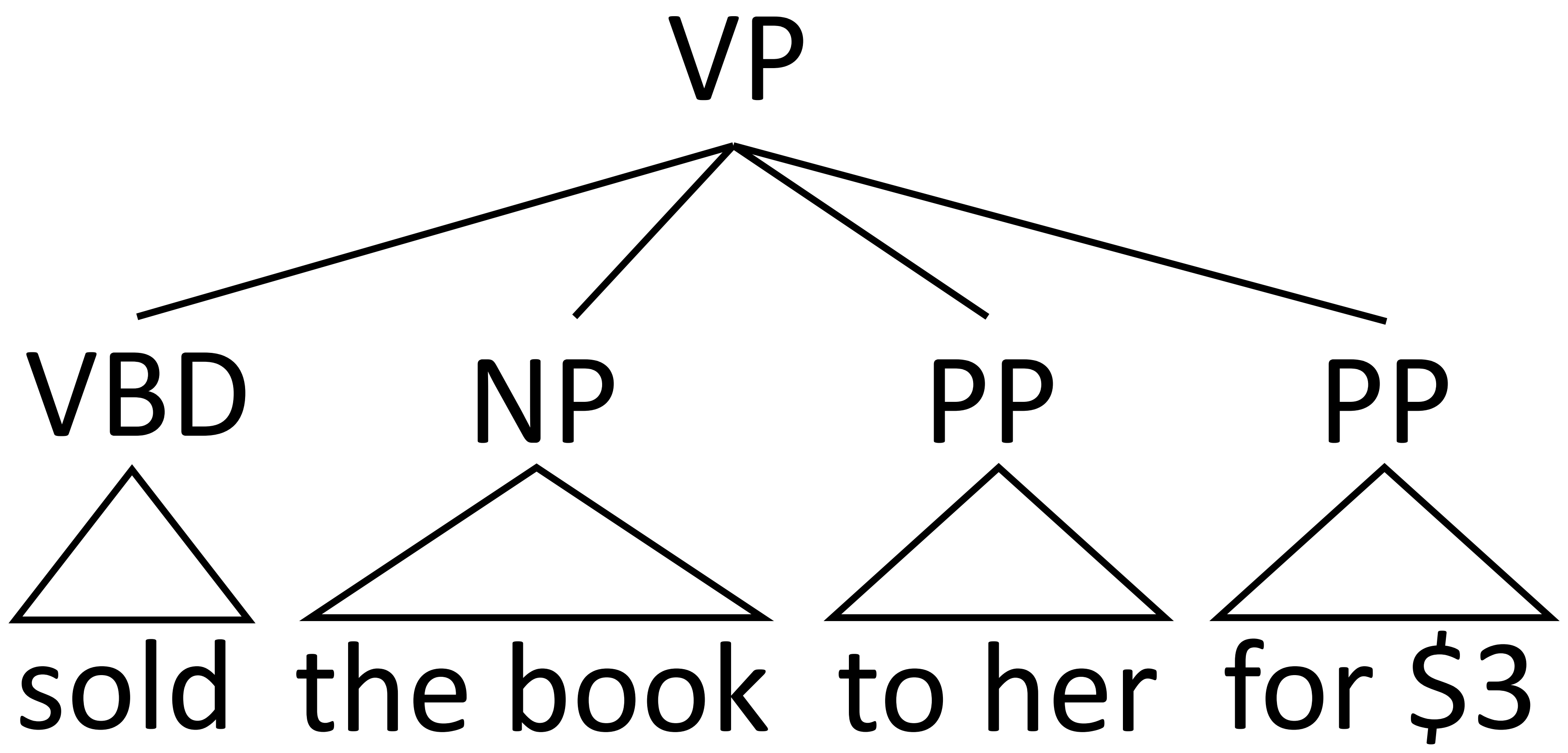
Results

- Standard dataset for English: Penn Treebank (Marcus et al., 1993)
- “Vanilla” PCFG: ~71 F1
- Best PCFGs for English: ~90 F1
- State-of-the-art discriminative models (using unlabeled data): 95 F1
- Other languages: results vary widely depending on annotation + complexity of the grammar

Grammar Preprocessing

Binarization

- To parse efficiently, we need our PCFGs to be at most binary (not CNF)

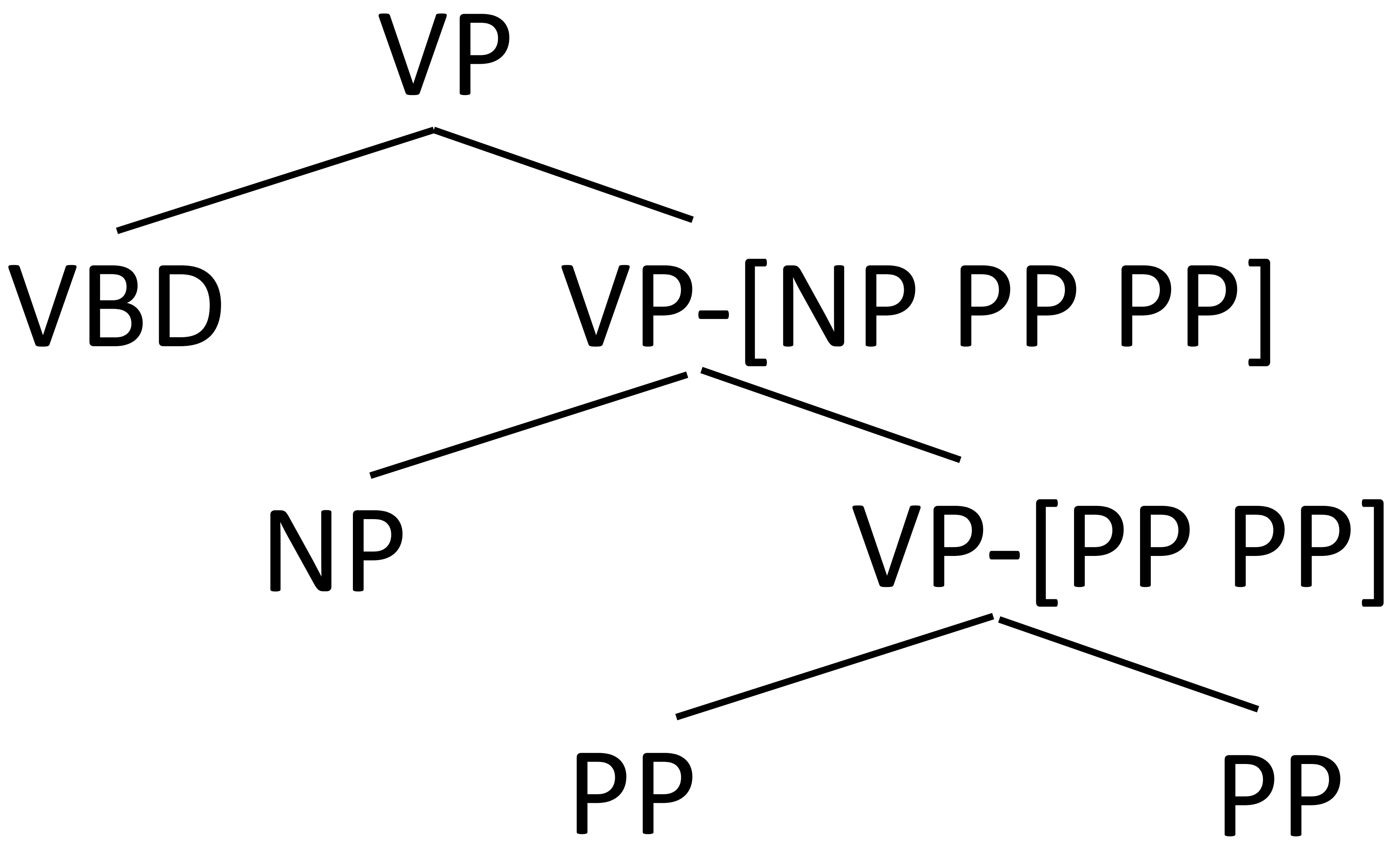


$P(VP \rightarrow VBD\ NP\ PP\ PP) = 0.2$

$P(VP \rightarrow VBZ\ PP) = 0.1$

…

- Solution: transform the trees. Introduce intermediate special symbols that rewrite deterministically

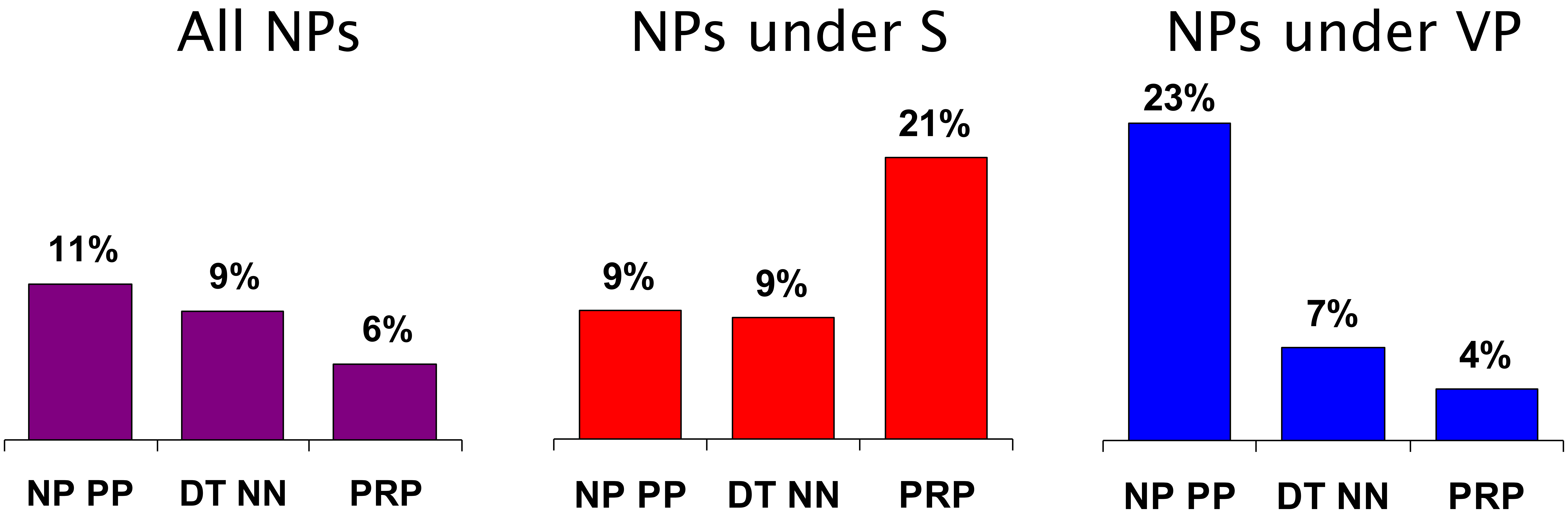


$P(VP \rightarrow VBD\ VP\text{-}[NP\ PP\ PP]) = 0.2$

$P(VP\text{-}[NP\ PP\ PP] \rightarrow NP\ VP\text{-}[PP\ PP]) = 1.0$

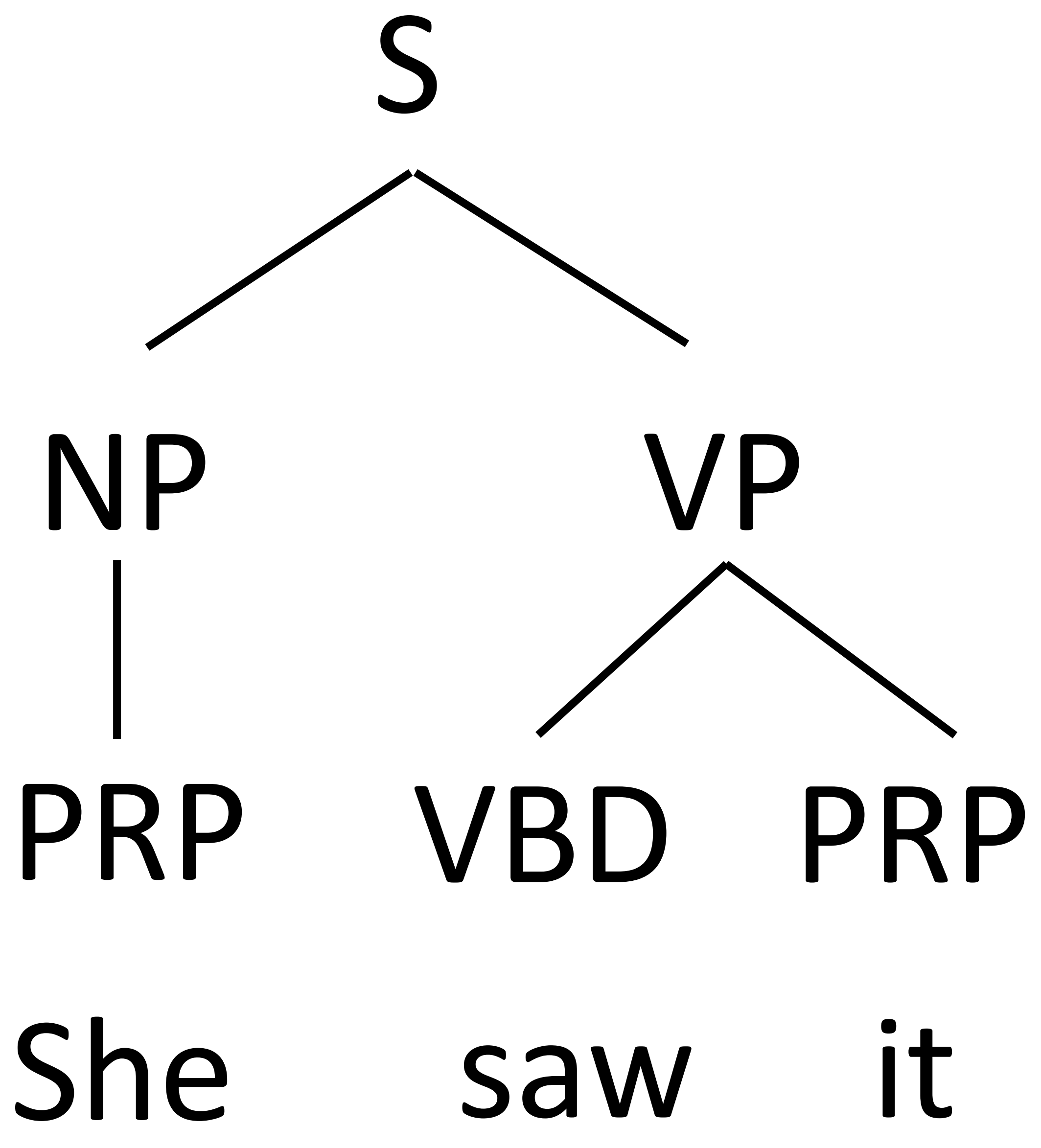
$P(VP\text{-}[PP\ PP] \rightarrow PP\ PP) = 1.0$

PCFG Independence Assumptions

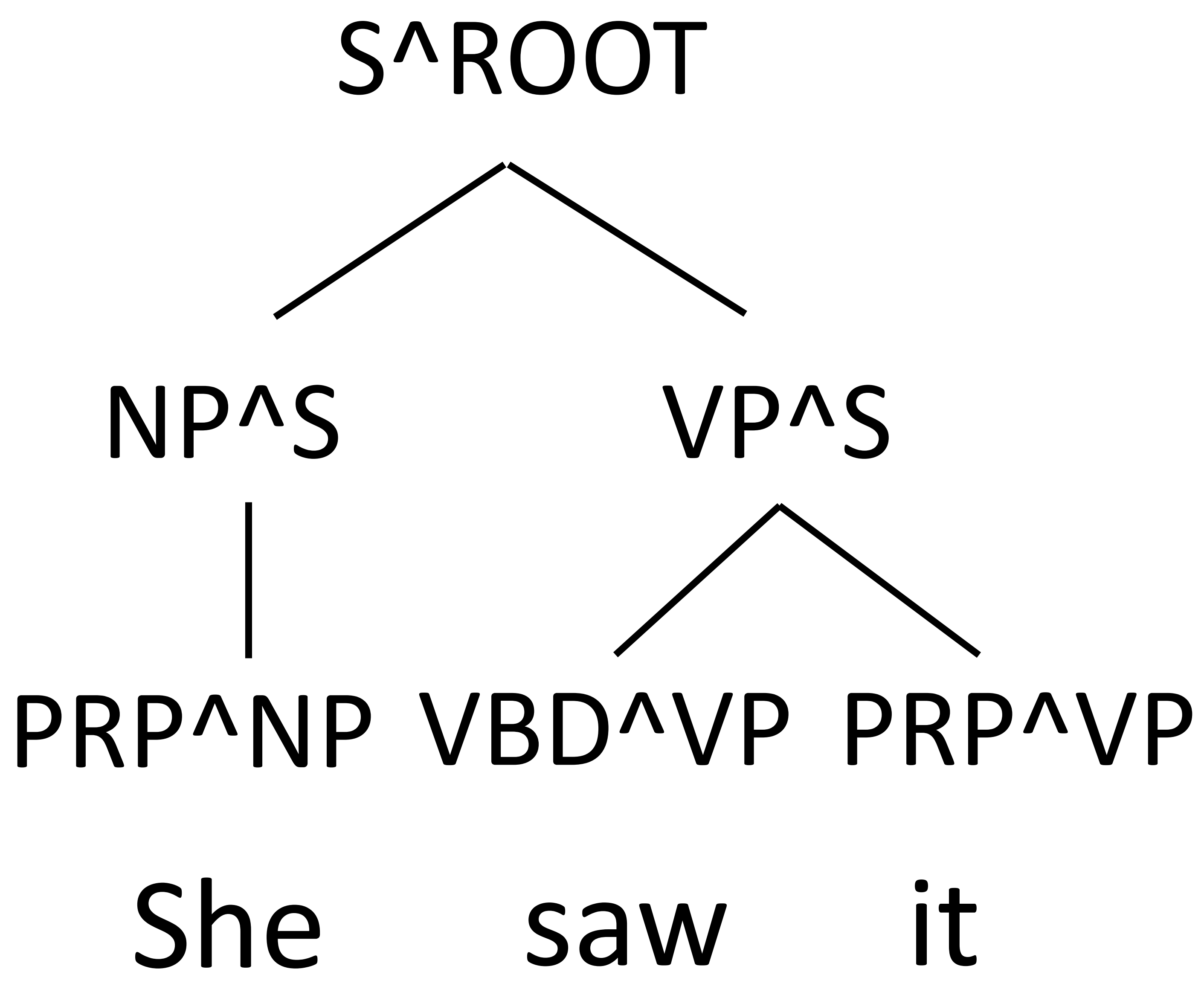


- Language is not context-free: NPs in different contexts rewrite differently
- [They]$_{NP}$ received [the package of books]$_{NP}$

Vertical Markovization



Basic tree (v = 1)

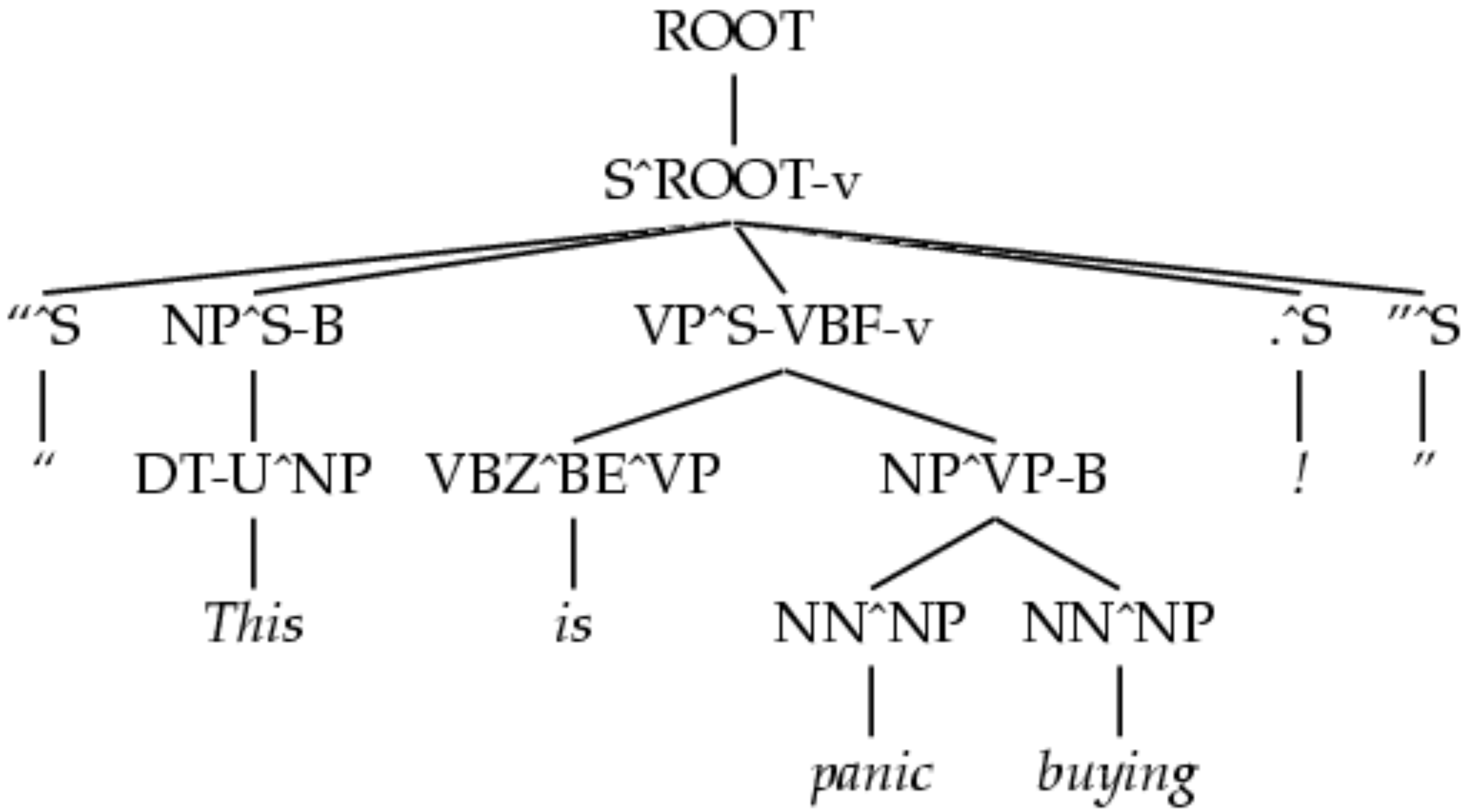


v = 2 Markovization

- Why is this a good idea?

Annotated Tree

- Augment the grammar: deterministically transform symbols to be "less context free" (binarization not shown here)

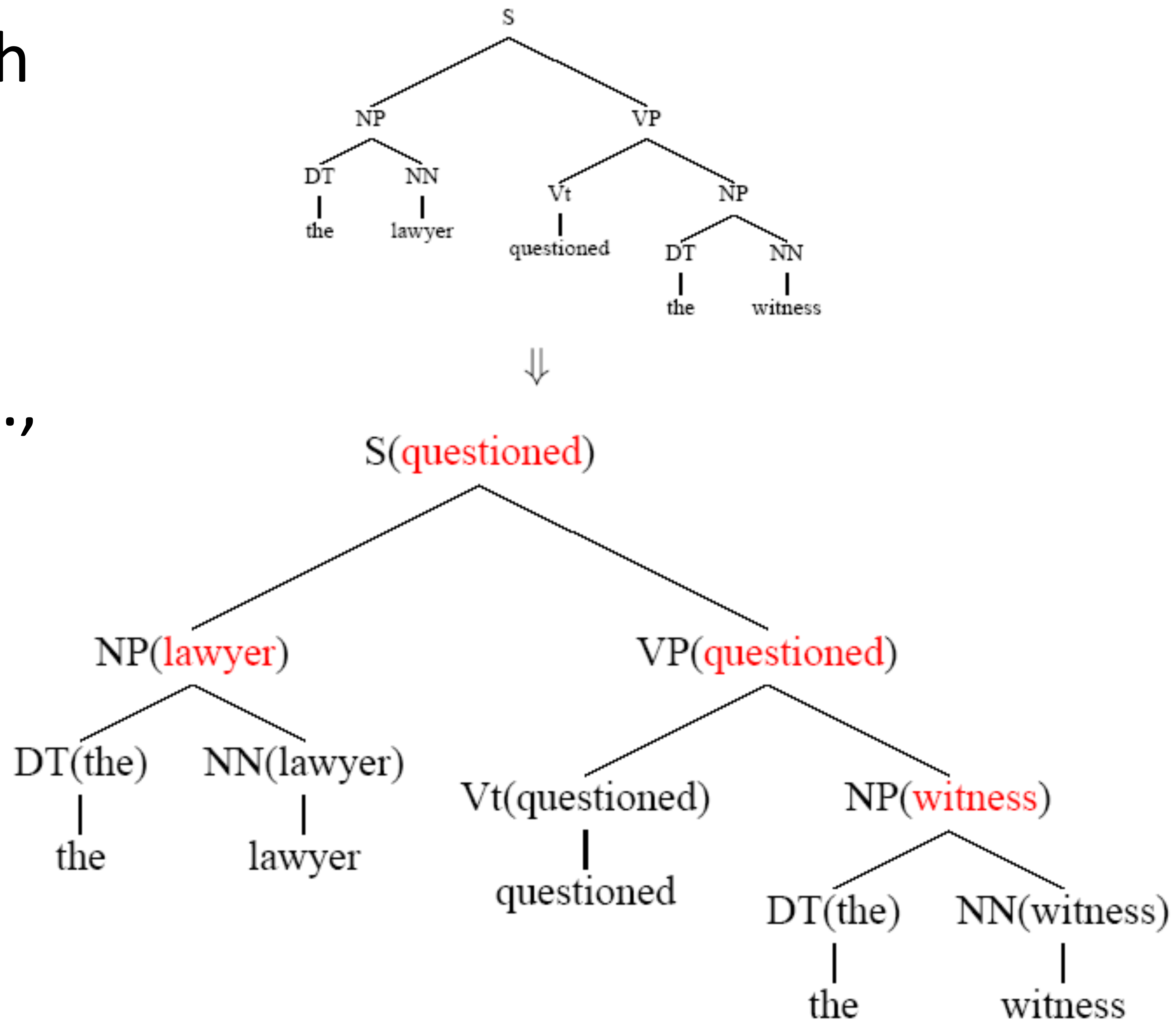


- 75 F1 with basic PCFG => 86.3 F1 with this highly customized PCFG (SOTA was 90 F1 at the time, but with more complex methods)

Klein and Manning (2003)

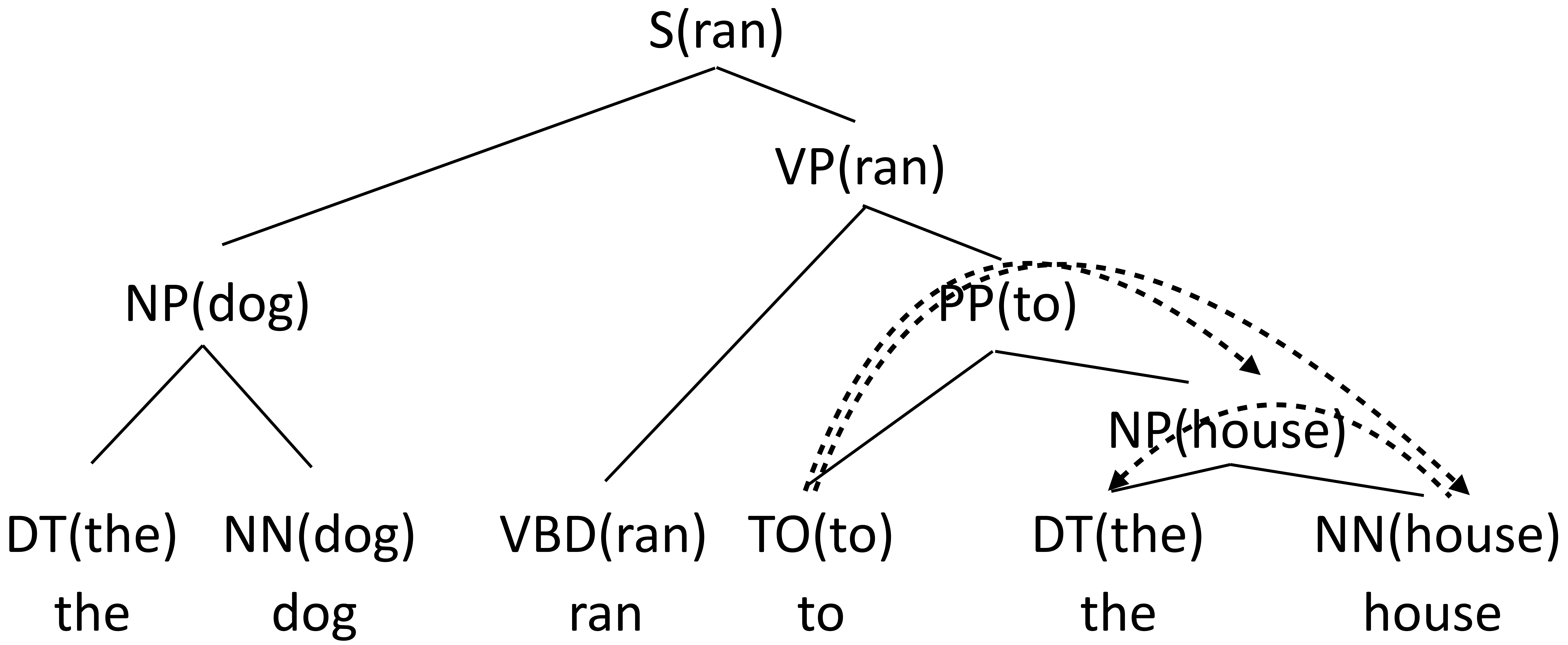
Lexicalized Parsers

- Annotate each grammar symbol with its "head word": most important word of that constituent
- Rules for identifying headwords (e.g., the last word of an NP before a preposition is typically the head)
- Collins and Charniak (late 90s): ~89 F1 with these



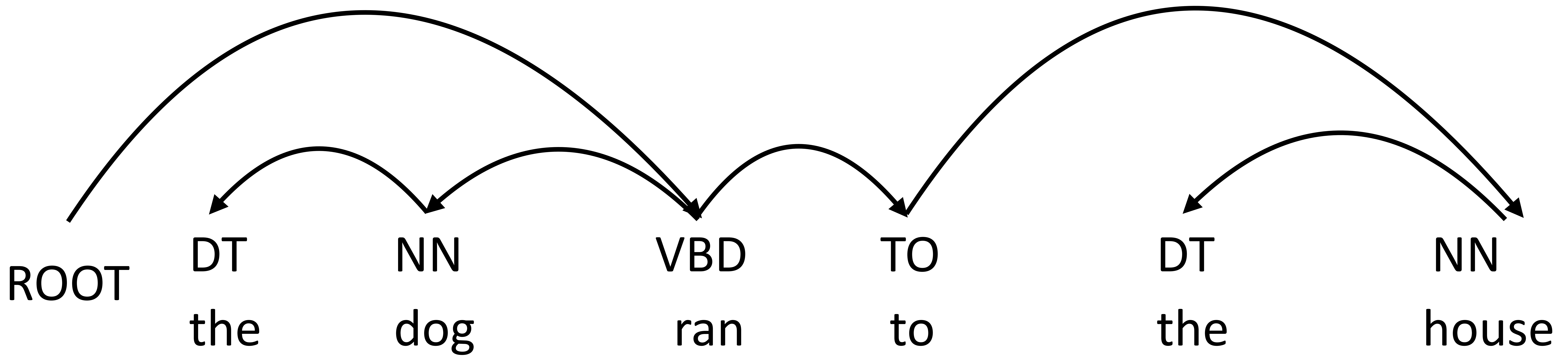
Dependency Parsing

Lexicalized Parsing



Dependency Parsing

- Dependency syntax: syntactic structure is defined by these arcs
  - Head (parent, governor) connected to dependent (child, modifier)
  - Each word has exactly one parent except for the ROOT symbol, dependencies must form a directed acyclic graph



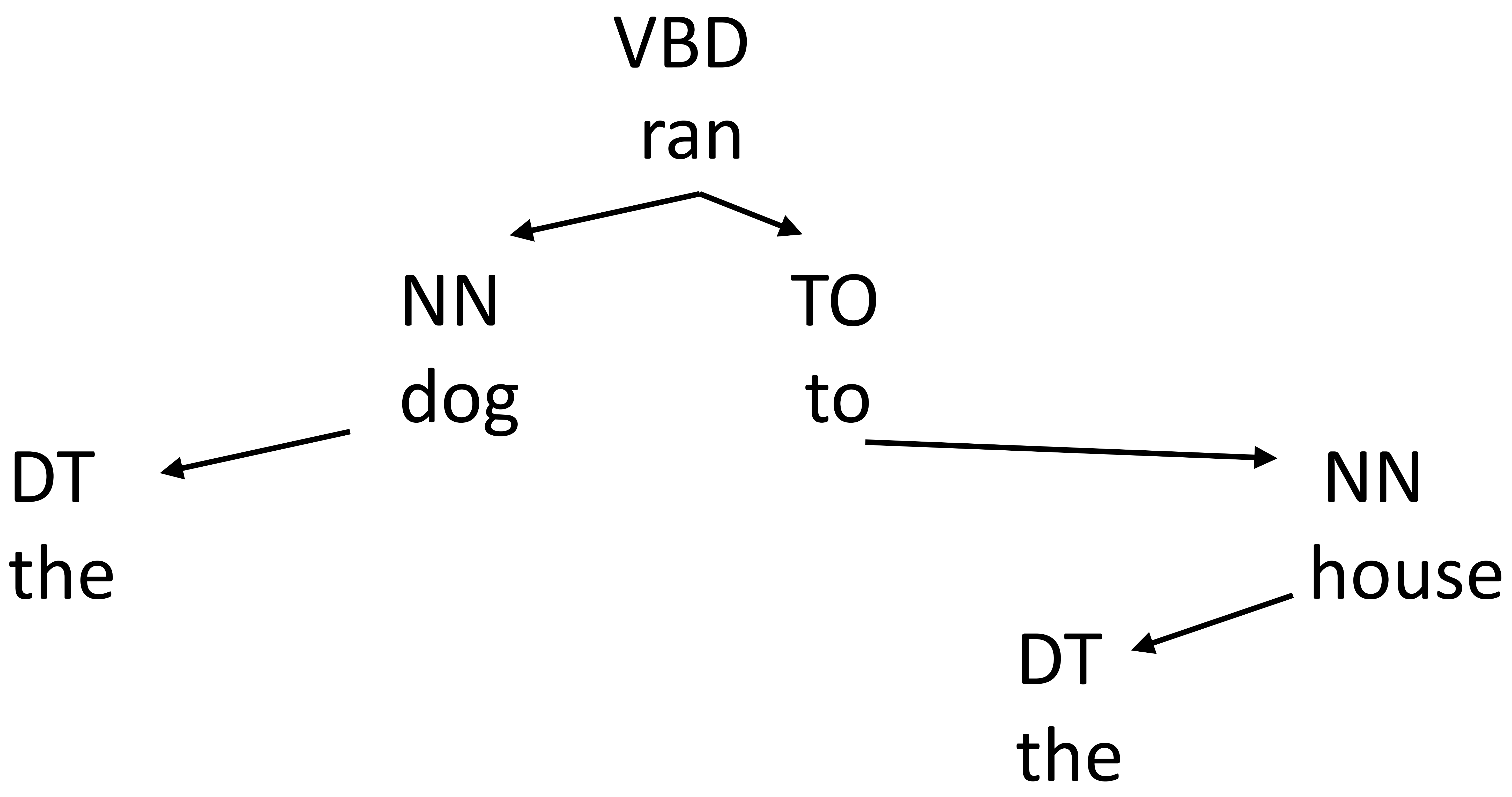
- POS tags same as before, usually run a tagger first as preprocessing

Why are they defined this way?

- Constituency tests:
  - Substitution by *proform*: the dog *did so [ran to the house]*, *he [the dog]* ran to the house
  - Clefting (*It was [to the house] that the dog ran*…)
- Dependency: verb is the root of the clause, everything else follows from that
  - No notion of a VP!

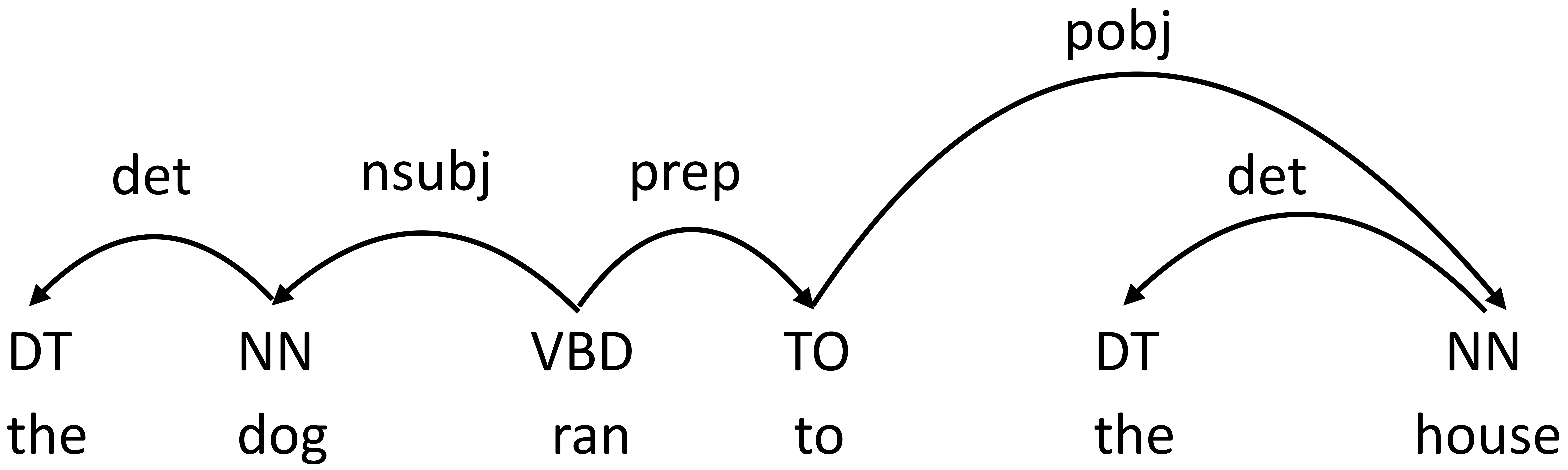
Dependency Parsing

- Still a notion of hierarchy! Subtrees often align with constituents



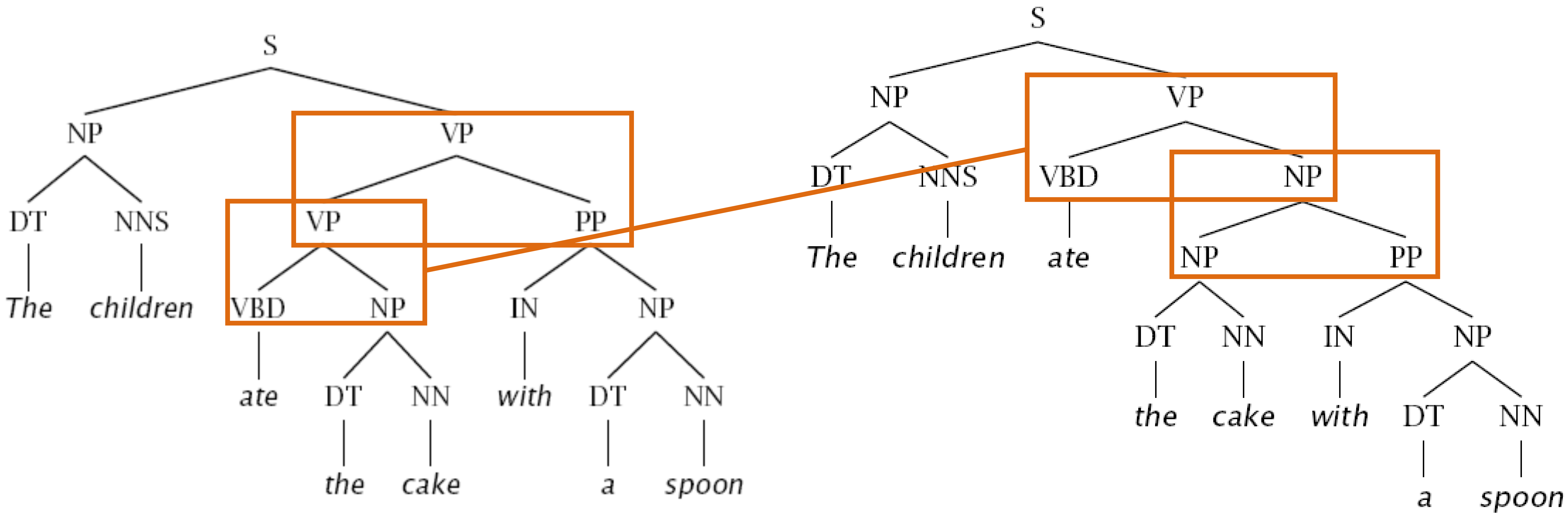
Dependency Parsing

- Can label dependencies according to syntactic function
- Major source of ambiguity is in the structure, so we focus on that more (labeling separately with a classifier works pretty well)



Dependency vs. Constituency: PP Attachment

- Constituency: several rule productions need to change



Dependency vs. Constituency: PP Attachment

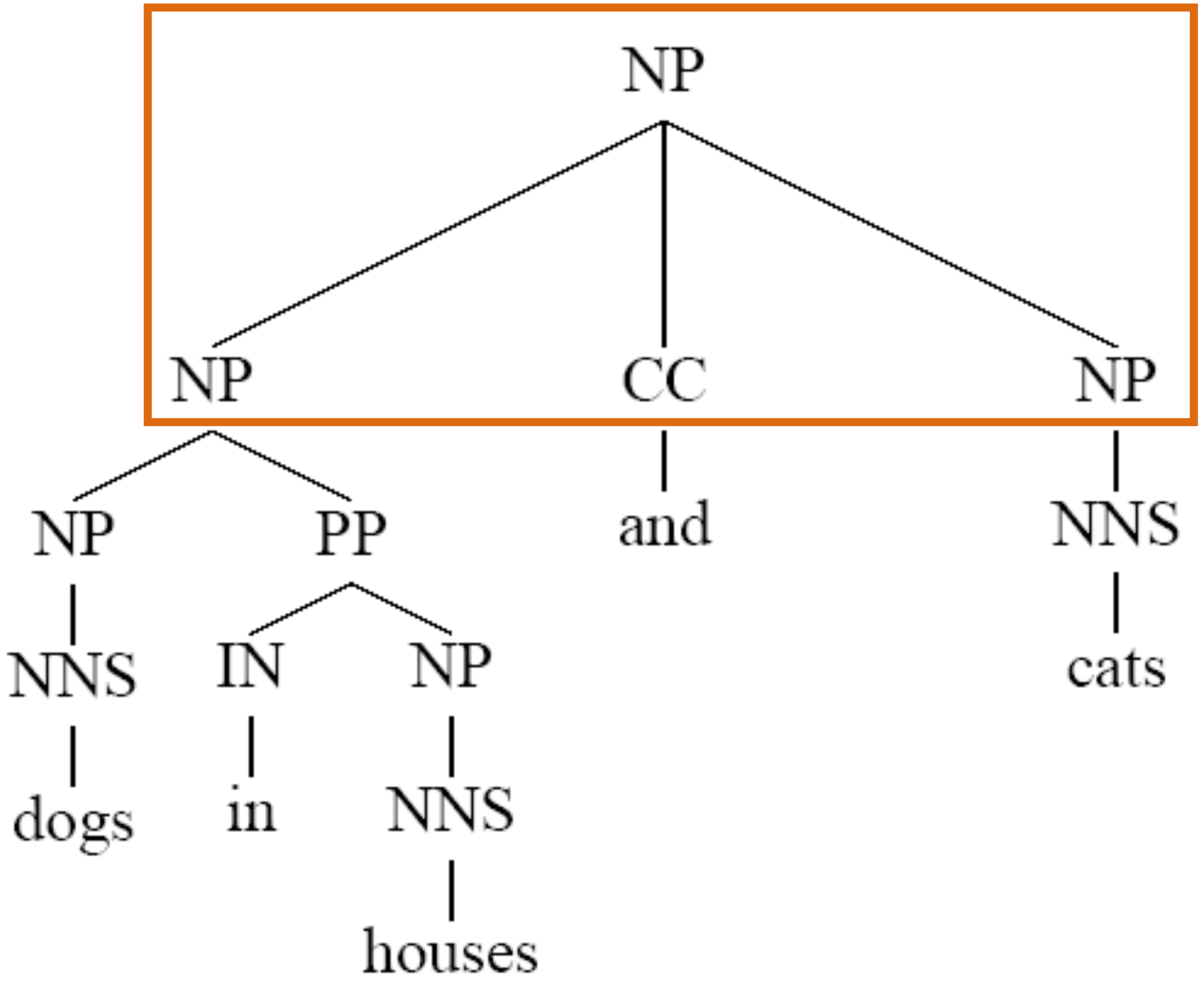
- Dependency: one word (with) assigned a different parent

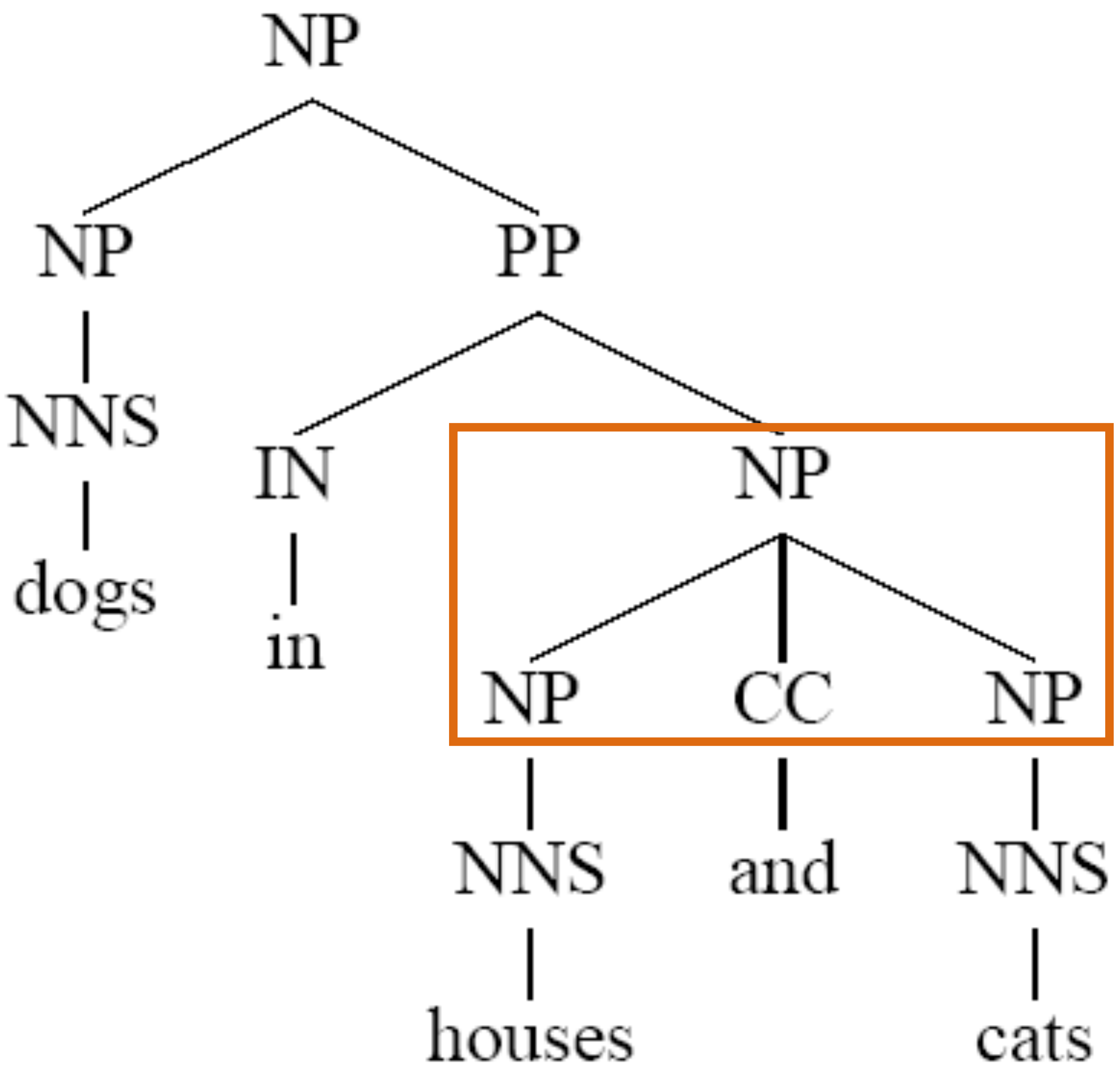
the children ate the cake with a spoon

- corenlp.run: *spoon* is child instead of *with*. This is just a different formalism
- More predicate-argument focused view of syntax
- "What's the main verb of the sentence? What is its subject and object?" — easier to answer under dependency parsing

Dependency vs. Constituency: Coordination

- Constituency: ternary rule NP -> NP CC NP





Dependency vs. Constituency: Coordination

- Dependency: first item is the head

dogs in houses **and cats**

[dogs in houses] and cats

dogs in **houses and cats**

dogs in [houses and cats]

- Coordination is decomposed across a few arcs as opposed to being a single rule production as in constituency
- Can also choose *and* to be the head
- In both cases, headword doesn't really represent the phrase — constituency representation makes more sense

Shift-Reduce Parsing
(see notes)