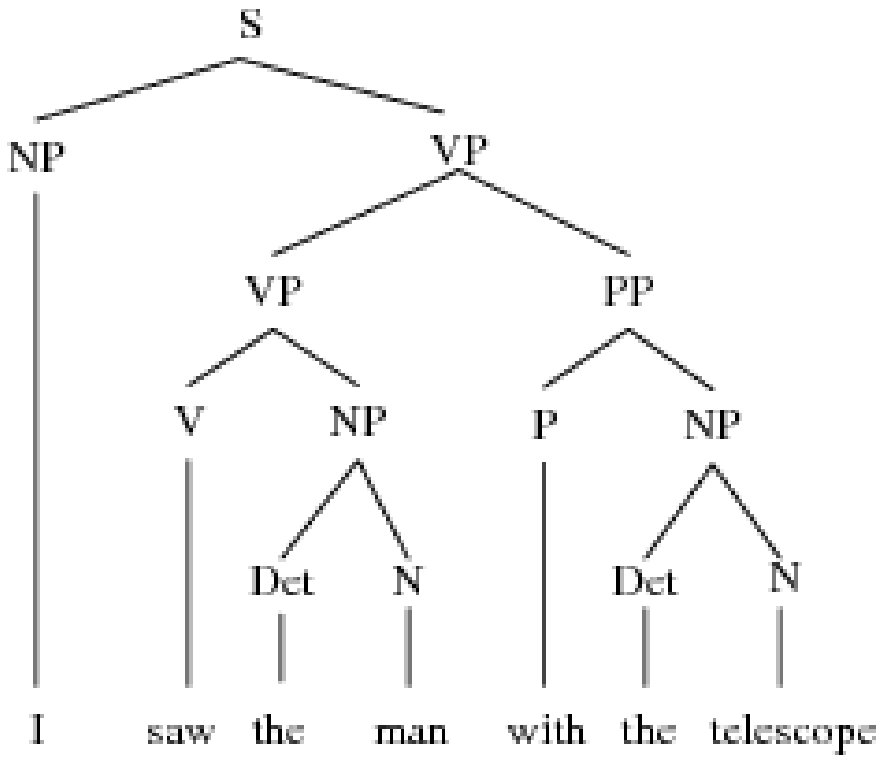
Probabilistic Parsing

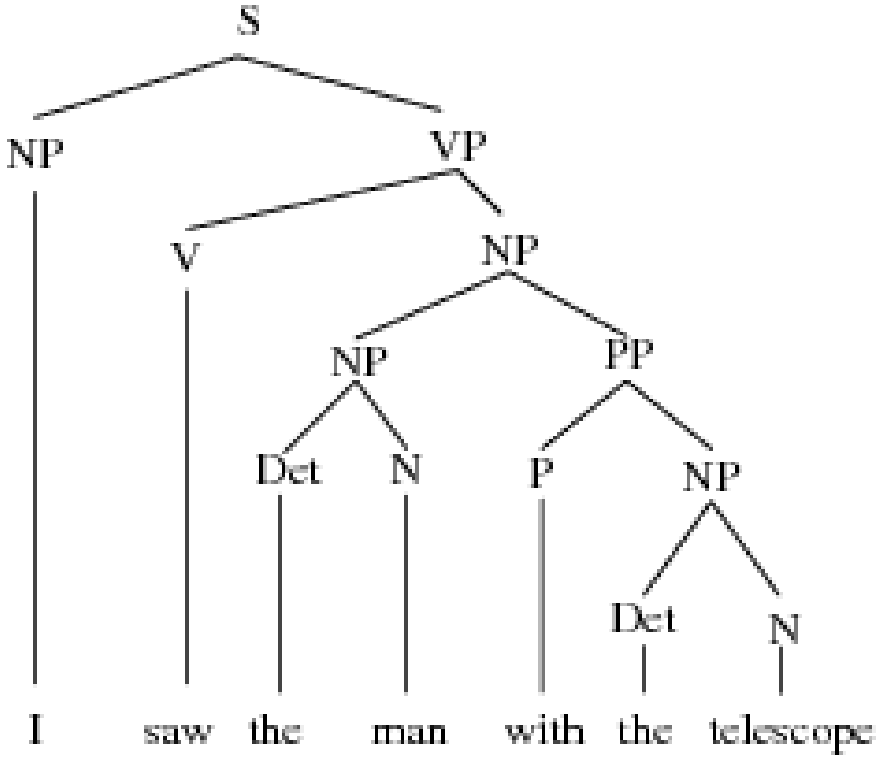
*"... the overall goal is to produce a system that can place a provably useful structure over arbitrary sentences, that is, to build a **parser**."*

tags: chunking, grammar induction, parser

12.1.1 Parsing for disambiguation

- Probabilities for determining the sentence
- Probabilities for speedier parsing
- *Probabilities for choosing between parses*





12.1.2 Treebanks

- A collection of example parses = treebank
- Penn Treebank tree:

```
(S
  (NP (PRP I))
  (VP (VBD saw)
   (NP (DT the) (NN man))
   (PP (IN with)
    (NP (DT the) (NN telescope))))
  (. .)))
```

  - NP-over-NP is wrong by syntactic theories
  - but captures the notion of chunks

tags: treebank, penn treebank, chunking

12.1.3 Parsing models vs. Language models

- parsing model: evaluates the probability of trees *t* for a sentence *s*

$$\hat{t} = arg\,max\, P(t|s, G)$$

- language model: assigns a probability to all trees generated by a grammar

$$\hat{t} = \underset{t}{arg\,max}\, P(t|s) = \underset{t}{arg\,max} \frac{P(t, s)}{P(s)} = \underset{t}{arg\,max}\, P(t, s)$$

- language models appear to provide a better foundation for modeling

tags: parsing model, language model

12.1.4 Weakening independence assumptions

- Context and independence assumptions
  - TV vs. Bar, who, immediate prior context
- PCFGs lack lexicalization
- Probabilities dependent on structural context

Expansion	% as 1st Obj	% as 2nd Obj
NP → NNS	7,5%	0,2%
NP → PRP	13,4%	0,9%
NP → NP PP	12,2%	14,4%
NP → DT NN	10,4%	13,3%
NP → NNP	4,5%	5,9%
NP → NNP	3,9%	9,2%
NP → JJ NN	1,1%	10,4%
NP → NP SBAR	0,3%	5,1%

tags: priming, lexicalization

12.1.5 Tree probabilities and derivational prob.

- Canonical derivation
- History-based grammars

tags: canonical derivation, history-based grammars

12.1.6 There's more than one way to do it

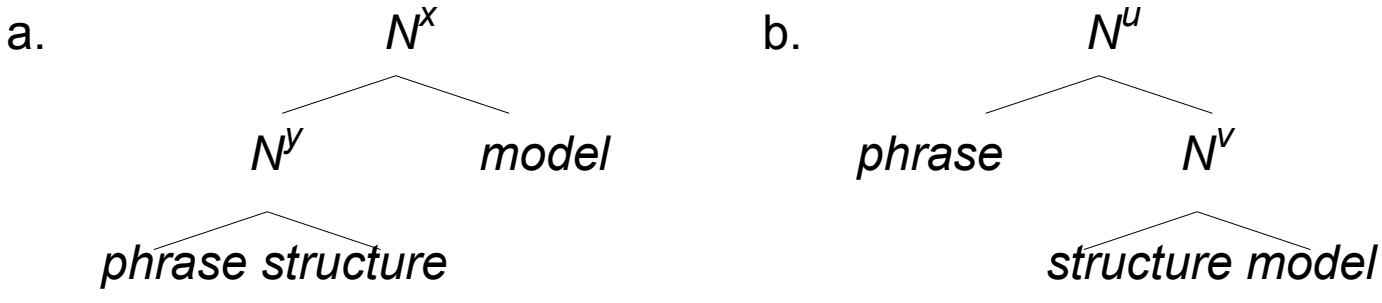
- Probabilistic left-corner grammars

```
comment: Initialization
Place the predicted start symbol S on top of the stack
comment: Parser
while (an action is possible) do one of the following
    actions
    [Shift] Put the next input symbol on top of the stack
    [Attach] If αα is on top of the stack, remove both
    [Project] If α is on top of the stack ans A → αγ, replace α by γA
    endactions
end
comment: Termination
if empty(input) ^ empty(stack)
    then
        exit success
    else
        exit failiure
fi
```

tags: top-down parsing, left corner parsers, shifting, projecting, attaching

12.1.7 Phrase structure / dependency grammars

- [phrase structure] is not really needed to construct an understanding of sentences



tags: dependency grammar, head

12.1.8 Evaluation

- Objective criterion
- Tree accuracy
- Exact match
- PARSEVAL measures
- Precision
- Recall
- Crossing Brackets

12.1.9 Equivalent models

- Three ways of thinking of a PCFG model
  - as using more of the derivational history
  - as using more of the parse tree context
  - as enriching the category labels
- *„.. it is frequently easier to write a quick program to produce transformed trees than to write a new probabilistic parser“*

12.1.10 Building Parsers: Search methods

- Tableau / Viterbi Algorithm
- Stack decoding algorithm
  - Uniform-cost search
  - Beam search
- A* search
  - Best-first search
  - A* search
  - Optimally efficient
- Other methods

12.1.11 Useof the geometric mean

- Multiplying probabilities -> errors accumulate
- *Ad hoc* scoring functions
  - Treating the symptoms not the problems
- PCFGs give higher probability to smaller trees