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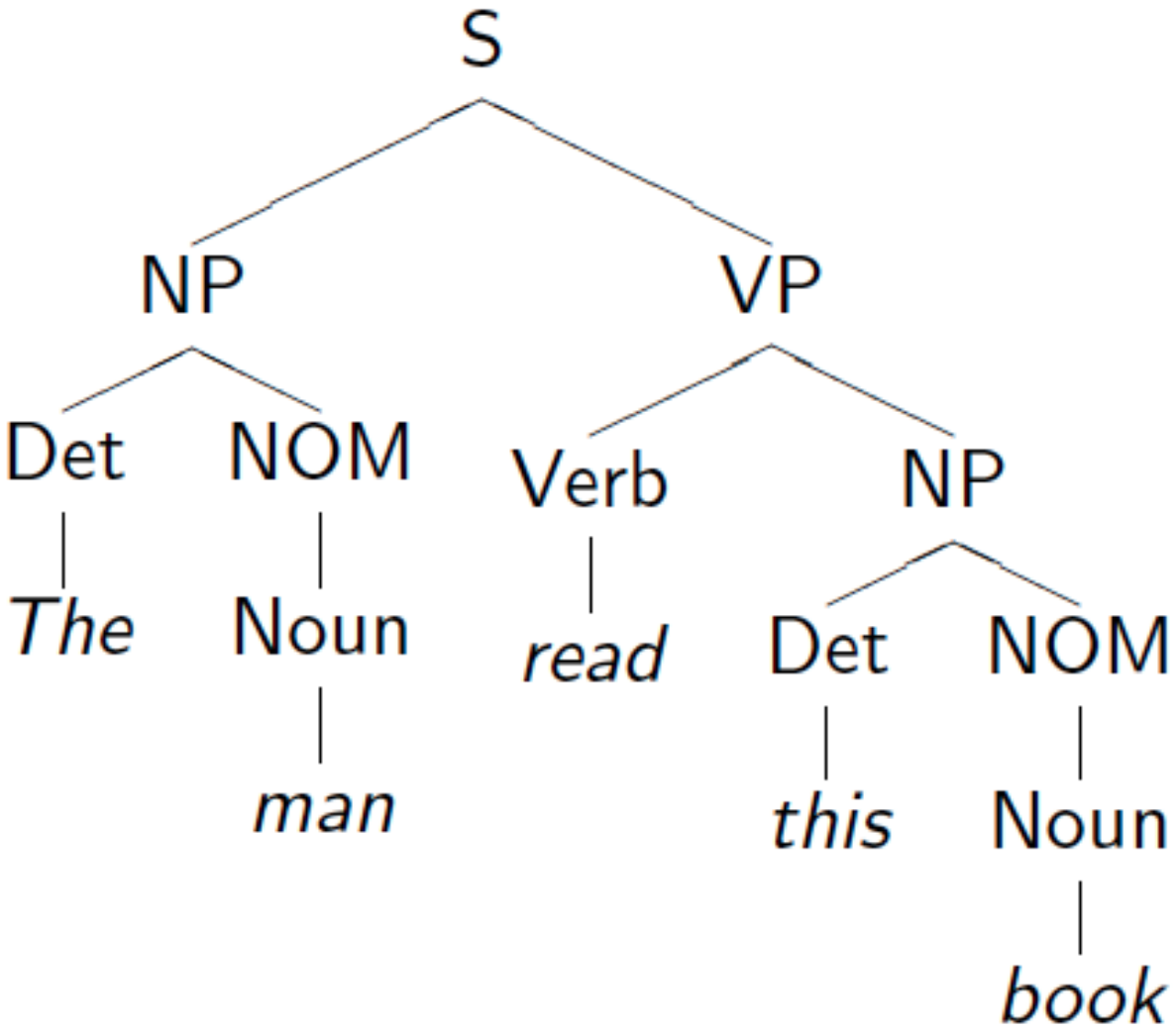
Syntax Tree: Example



Defining the notions: Constituency

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A group of words acts as a single unit - phrases, clauses etc.

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Constituency: Noun Phrase

- *Kermit the frog*
- *they*
- *December twenty-sixth*
- *the reason he is running for president*

Constituent Phrases

Usually named based on the word that heads the constituent:

the man from Amherst	is a Noun Phrase (NP) because the head man is a noun
extremely clever	is an Adjective Phrase (AP) because the head clever is an adjective
down the river	is a Prepositional Phrase (PP) because the head down is a preposition
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Joe appears in a place that a larger noun phrase could have been.

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Kermit the frog comes on stage
They come to Massachusetts every summer
December twenty-sixth comes after Christmas
The reason he is running for president comes out only now.

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**The comes our...* **is comes out...* **for comes out...*

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Consituent = Prepositional phrase: *On December twenty-sixth*
On December twenty-sixth I'd like to fly to Florida.
I'd like to fly on December twenty-sixth to Florida.
I'd like to fly to Florida on December twenty-sixth.
But not split apart
**On December I'd like to fly twenty-sixth to Florida.*
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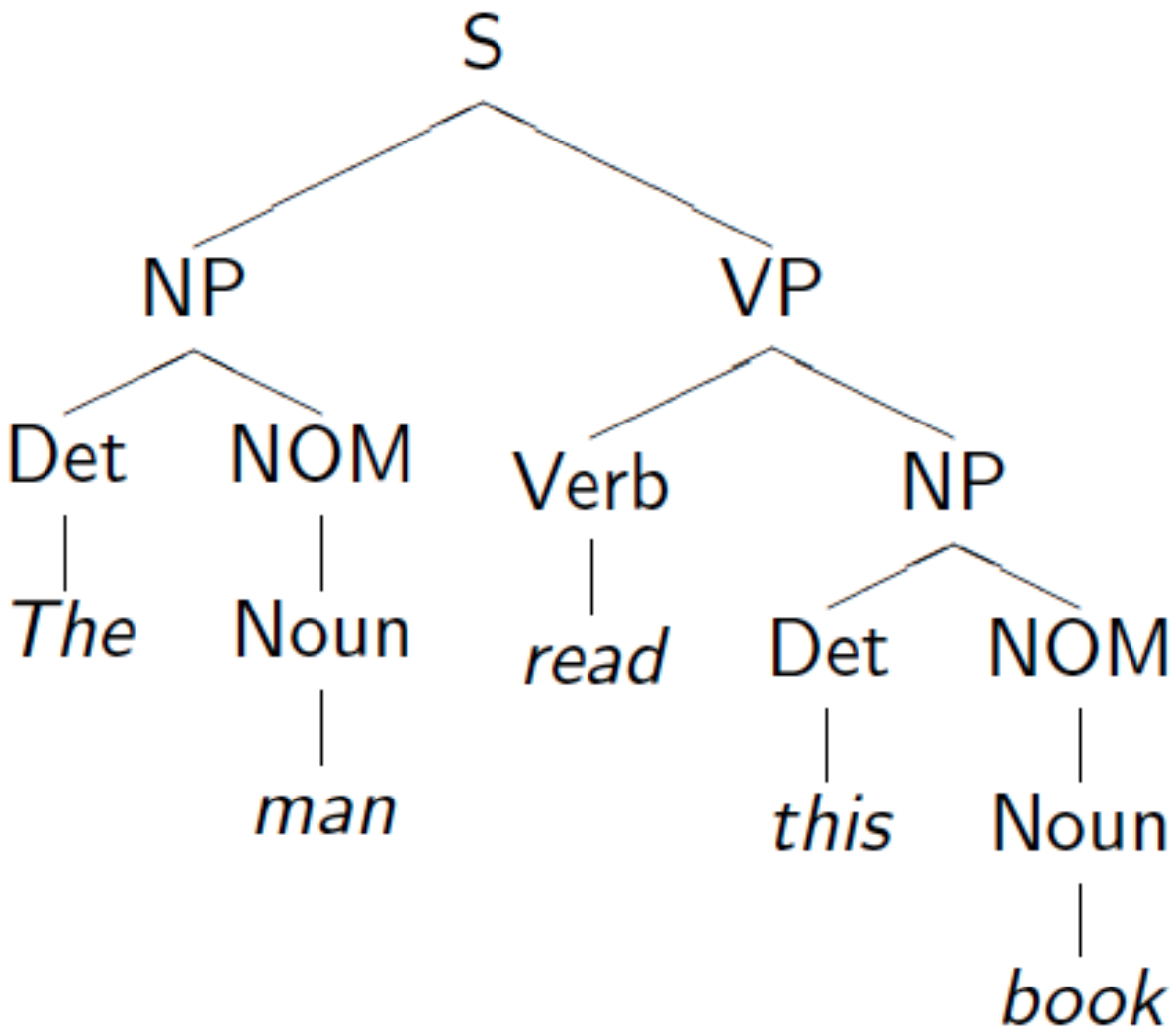
Modeling Constituency: what tool do we need?



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$NP \rightarrow$ Det Nominal

$NP \rightarrow$ ProperNoun

$Nominal \rightarrow$ Noun | Noun Nominal

CFG for Languages

CFG for Languages

CFG: $G = (T, N, S, R)$

- T: set of terminals
- N: set of non-terminals
  - For NLP, we distinguish out a set $P \subset N$ of pre-terminals, which always rewrite as terminals
- S : start symbol
- R: Rules/productions of the form $X \rightarrow \gamma$, $X \in N$ and $\gamma \in (T \cup N)*$

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Terminals and pre-terminals

Terminals mainly correspond to words in the language while pre-terminals mainly correspond to POS categories

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Can you identify the terminal, non-terminals and preterminals?

CFG as a generator

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- Thus a CFG can be used to randomly generate a series of strings
- This sequence of rule expansions is called a derivation of the string of words, usually represented as a tree

CFGs and Grammaticality

A CFG defines a formal language = set of all sentences (string of words) that can be derived by the grammar

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- Sentences in this set are said to be **grammatical**
- Sentences outside this set are said to be **ungrammatical**

CFGs and Recursion

Recursive Definition

- PP → Prep NP
- NP → Noun PP

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Example Sentence

[$_S$The mailman ate his [$_{NP}$ lunch [$_{PP}$ with his friend [$_{PP}$ from the cleaning staff [$_{PP}$ of the building [$_{PP}$ at the intersection [$_{PP}$ on the north end [$_{PP}$ of town]]]]]]].

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$A \rightarrow BC$

- I can rewrite A as *B followed by C* regardless of the context in which A is found
- Or when I see a *B followed by a C*, I can infer an A regardless of the surrounding context