Computational Linguistics

Lecture 7

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PARSING WITH CONTEXT-FREE GRAMMARS

What's wrong with....

- Top-Down parsers never explore illegal parses (e.g. can't form an S) -- but waste time on trees that can never match the input.

- Bottom-Up parsers never explore trees inconsistent with input -- but waste time exploring illegal parses (no S root).

A Top-Down Parsing Strategy

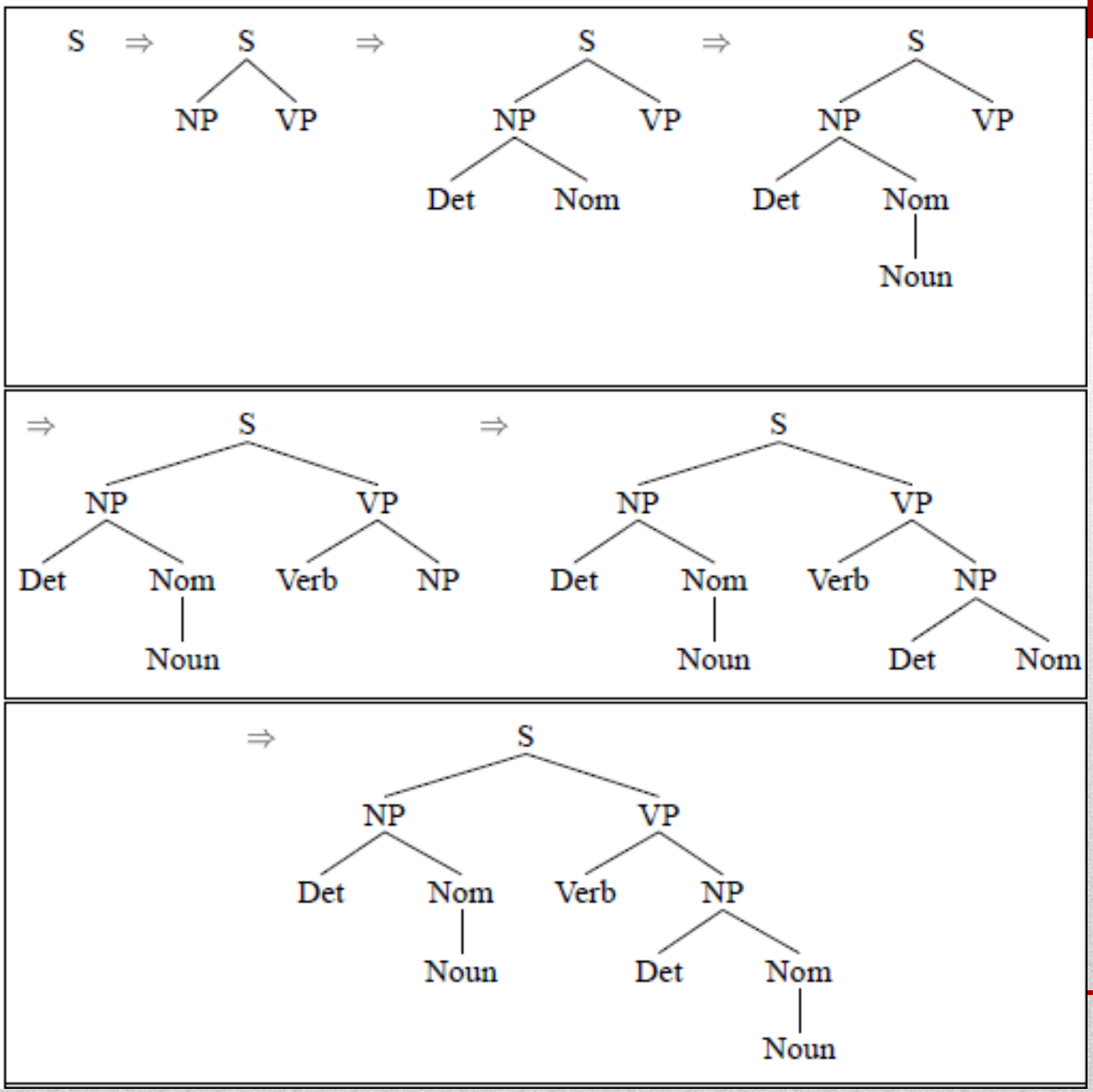
➢**Depth-first search**:

- Agenda of search states: expand search space incrementally, exploring most recently generated state (tree) each time.

- When you reach a state (tree) inconsistent with input, backtrack to most recent unexplored state (tree).

$S \rightarrow NP\ VP$	$Det \rightarrow that \mid this \mid a$
$S \rightarrow Aux\ NP\ VP$	$Noun \rightarrow book \mid flight \mid meal \mid money$
$S \rightarrow VP$	$Verb \rightarrow book \mid include \mid prefer$
$NP \rightarrow Det\ Nominal$	$Aux \rightarrow does$
$Nominal \rightarrow Noun$	
$Nominal \rightarrow Noun\ Nominal$	$Prep \rightarrow from \mid to \mid on$
$NP \rightarrow Proper\text{-}Noun$	$Proper\text{-}Noun \rightarrow Houston \mid TWA$
$VP \rightarrow Verb$	
$VP \rightarrow Verb\ NP$	$Nominal \rightarrow Nominal\ PP$

The flight include a meal



The flight include a meal

A Top-Down Parsing Strategy

- Which node to expand?
  - **Leftmost** or rightmost

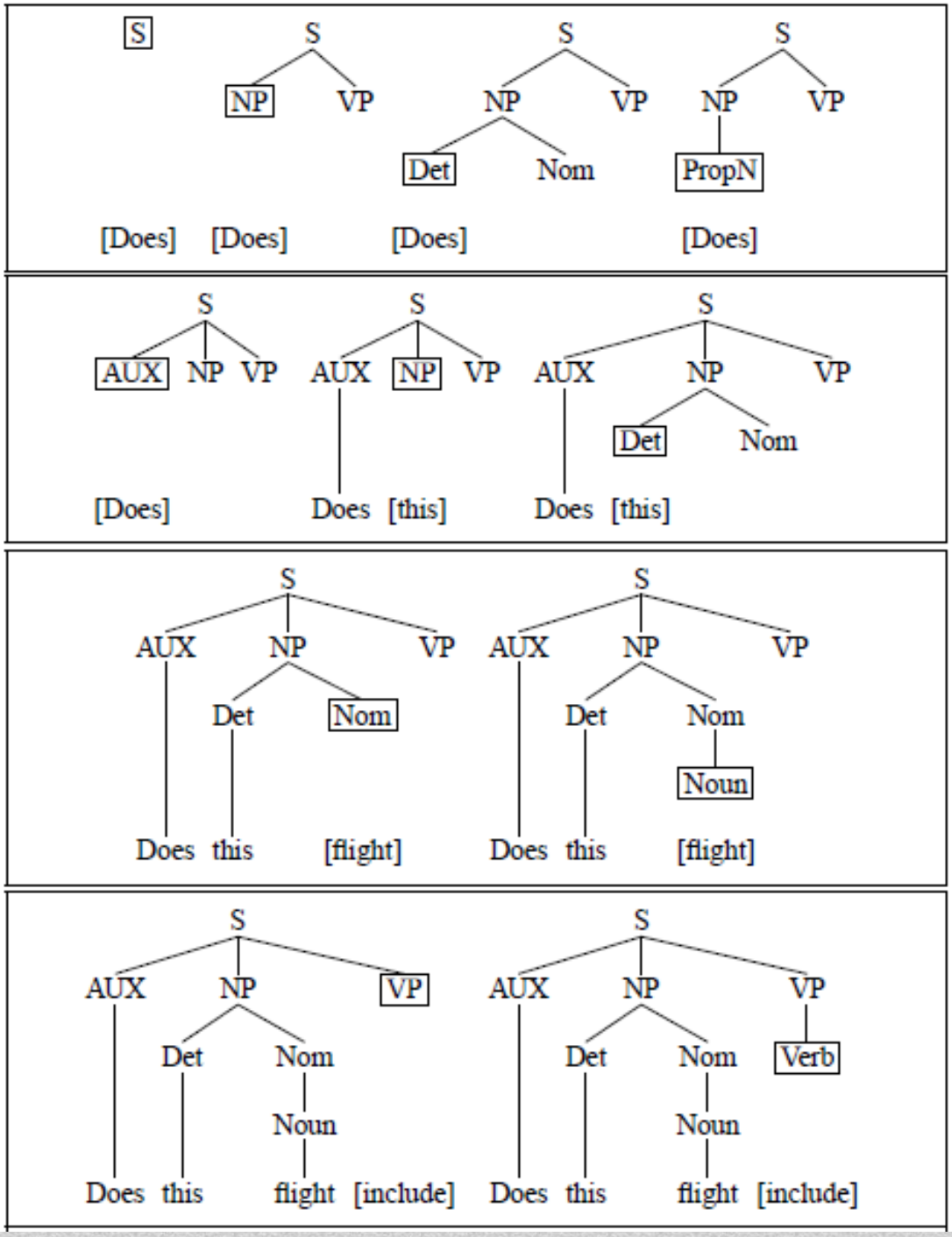
    Leftmost

- Which grammar rule to use?
  - Order in the grammar??

    Yes

Top-Down, Depth-First, Left-Right Strategy

Does this flight include a meal



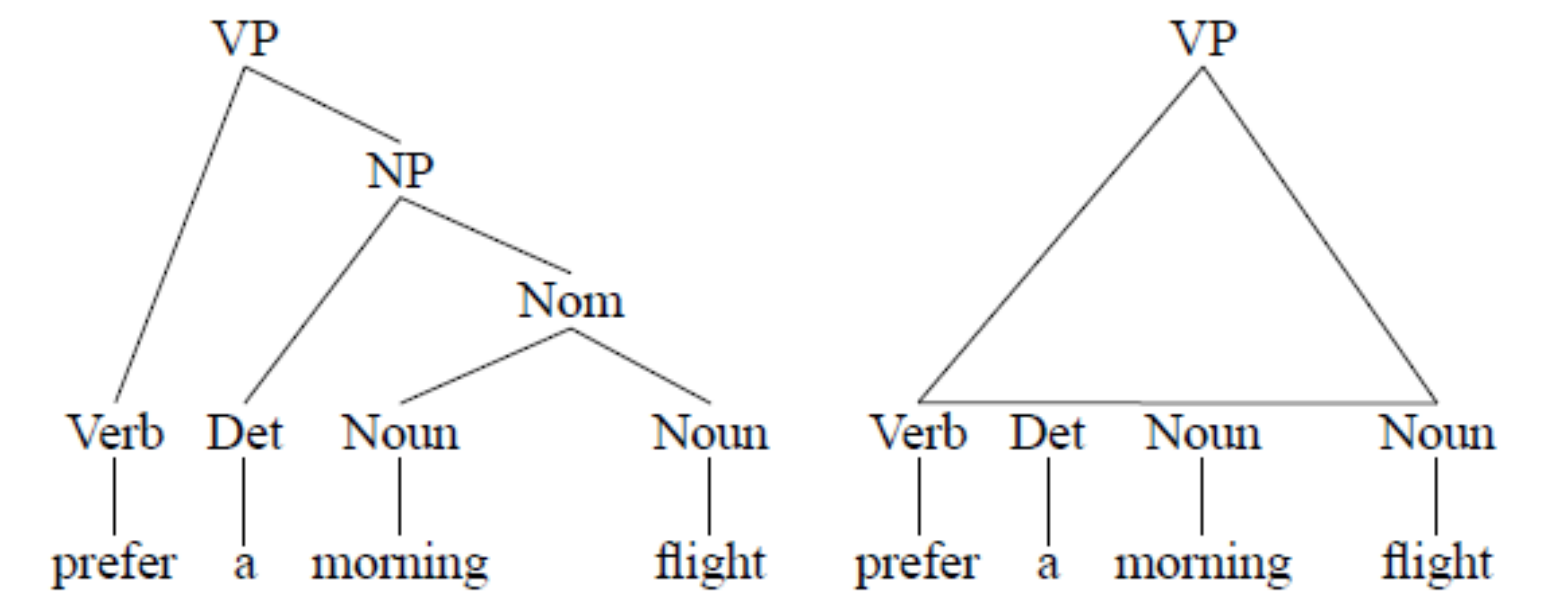
Left Corners: Top-Down Parsing with Bottom-Up Filtering

- Beginning at the root, the parser expands non-terminal symbols along the left edge of the tree, down to the word at the bottom left edge of the tree.

- The parser should not consider any grammar rule if the current input cannot serve as the *first word along the left edge of some derivation* from this rule.

- We call the first word along the left edge of a derivation the **left-corner** of the tree.

Left Corners



- We say that for non-terminals *A* and *B*, *B* is a left-corner of *A* if there is a derivation of *A* that begins with a *B*.

Left-Corner Table for CFG

Category	Left Corners
S	Det, Proper-Noun, Aux, Verb
NP	Det, Proper-Noun
Nominal	Noun
VP	Verb

- The table that lists all the valid left-corner categories for each non-terminal in the grammar.