Ling 566
Jan. 4, 2006

Introduction, Organization,
First Attempts at a Theory of Grammar, CFG

Overview

- Syllabus
- Prescriptive/descriptive grammar; Competence/performance
- Some history
- Why study syntax?
- Two theories that won’t work
- CFG

Two Conceptions of Grammar

PRESCRIPTIVE

- Rules against certain usages. Few if any rules for what **is** allowed
- Proscribed forms generally in use
- Explicitly normative enterprise

DESCRIPTIVE

- Rules characterizing what people do say
- Goal to characterize all and only what speakers find acceptable
- Tries to be scientific

Uses of Grammar

PRESCRIPTIVE

- Identify speaker's socioeconomic class & education level
- Identify level of formality of a particular usage

DESCRIPTIVE

- Understand how people produce & understand language
- Identify similarities & differences across languages
- Development of language technologies

Prescriptive grammar

- Examples of silly prescriptive rules?
- Examples of useful prescriptive rules?
- Compling applications which might need to encode prescriptive rules?

Fill in the blanks:
he/*his*, *they*/*their*, or something else?

Everyone insisted that ___ record was unblemished.

Everyone drives ___ own car to work.

Everyone was happy because ___ passed the test.

Everyone left the room, didn't ___?

Everyone left early. ___ seemed happy to get home.

Descriptive Grammar: an example

F--- yourself!

Go f--- yourself!

F--- you!

*Go f--- you!

- Who taught you this?
- How did you learn it?

Kinds of Things We'll Worry About

- Where to use reflexives (e.g. *myself)* vs. ordinary pronouns (*I* or *me*)
- Agreement (e.g. *We sing* vs. **We sings*)
- Word order (e.g. **Sing we*)
- Case (e.g. **Us sing*)
- Coordinate conjunction (e.g. *We sing and dance*)
- How to form questions, imperatives, negatives…
- …and much more

Competence *vs*. Performance

- The Distinction
  - Competence - knowledge of language
  - Performance - how the knowledge is used
- Examples

  That Sandy left bothered me.

  That that Sandy left bothered me bothered Kim

  That that that Sandy left bothered me bothered Kim bothered Bo

  The horse raced past the barn fell

Acceptability *vs.* grammaticality

- A sentence is **acceptable** if native speakers say it sounds good.
- A sentence is **grammatical** (with respect to a particular grammar) if the grammar licenses it.
- Linguists are sometimes sloppy about the difference.

Some History

- Writings on grammar go back at least 3000 years
- Until 200 years ago, almost all of it was prescriptive
- Until 50 years ago, most linguistic work concerned sound systems (phonology), word structure (morphology), and the historical relationships among languages

The Generative Revolution

- Noam Chomsky's work in the 1950s radically changed linguistics, making syntax central.
- Chomsky has been the dominant figure in linguistics ever since.
- The theory we will develop is in the tradition started by Chomsky, but diverges from his work in many ways.

Main Tenets of Generative Grammar

- Grammars should be formulated precisely and explicitly
- Languages are infinite, so grammars must be tested against invented data, not just attested examples.
- The theory of grammar is a theory of human linguistic abilities.

Some of Chomsky's Controversial Claims

- The superficial diversity of human languages masks their underlying similarity.
- All languages are fundamentally alike because linguistic knowledge is largely innate.
- The central problem for linguistics is explaining how children can learn language so quickly and easily.

Family Tree of Syntactic Theories

Early Transformational Grammar
(1955-1964)
|
Standard Theory TG
(1964-1967)

EST
(1967-1977)

Generative Semantics
(1966-1975)

REST
(1977-1981)
|
GB
(1981-1993)
|
MP
(1993-present)

GPSG
(1979-1985)
|
HPSG
(1986-present)

Realistic TG
(1978-1980)
|
LFG
(1980-present)

RG
(1974-present)
|
APG
(1980)

Why Study Syntax?

- Why should linguists study syntax?
- Why should computational linguists study syntax?
- Should anyone else study syntax? Why?

Insufficient Theory #1

- A grammar is simply a list of sentences.
- What's wrong with this?

Insufficient Theory #2: FSMs

- the noisy dogs left

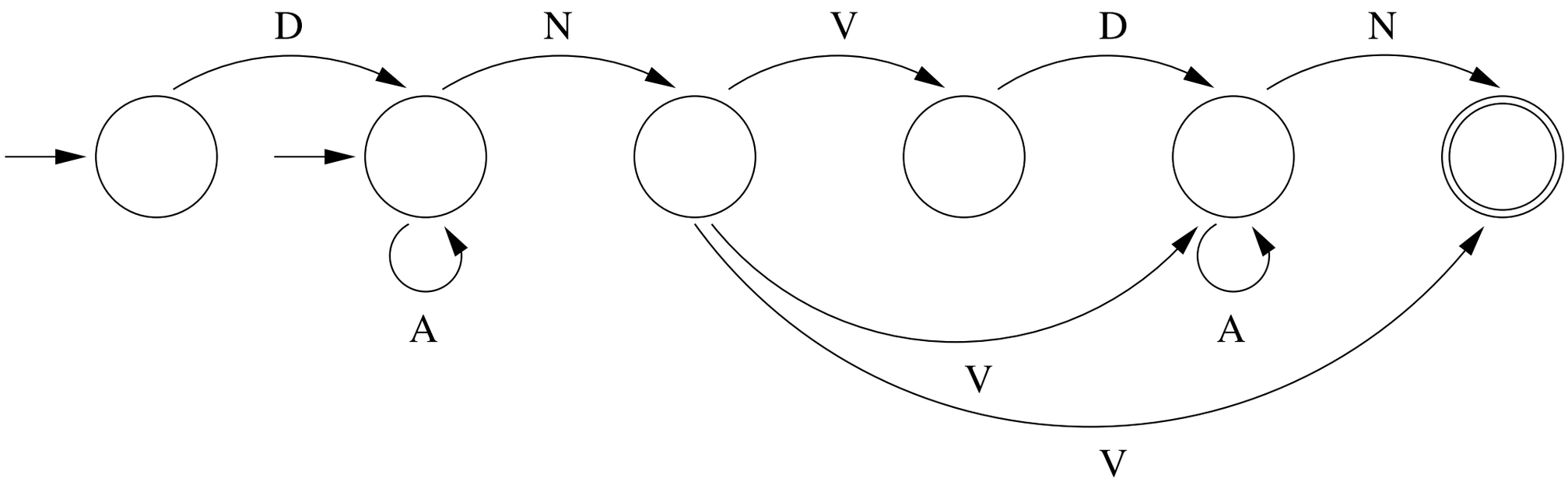
  D A N V

- the noisy dogs chased the innocent cats

  D A N V D A N

- $a^* = \{\emptyset, a, aa, aaa, aaaa, \ldots\}$
- $a^+ = \{a, aa, aaa, aaaa, \ldots\}$
- (D) A* N V ((D) A* N)

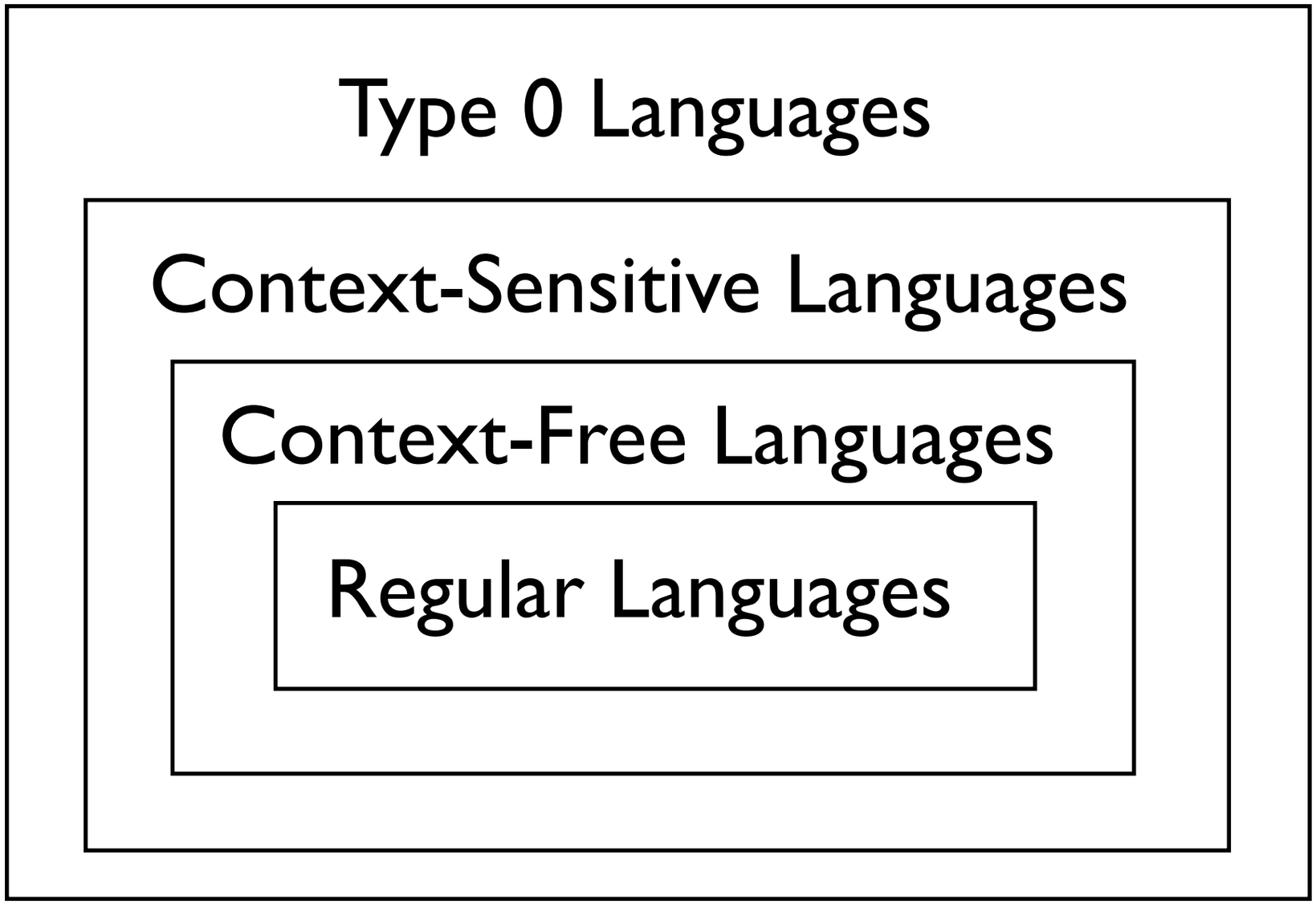
A Finite State Machine



FSMs for Grammar, cont

- Why are FSMs insufficient as a representation of natural language syntax?
- How might they be useful anyway?

Chomsky Hierarchy



Context-Free Grammar

- A quadruple: $< C, \Sigma, P, S >$
  - C: set of categories
  - $\sum$: set of terminals (vocabulary)
  - P: set of rewrite rules $\alpha \rightarrow \beta_1, \beta_2, \ldots, \beta_n$
  - S in C: start symbol
  - For each rule $a \rightarrow \beta_1, \beta_2, \ldots, \beta_n \in P$
    $a \in C;\ \beta_i \in C \cup \sigma;\ 1 \leq i \leq n$

A Toy Grammar

RULES

S ⟶ NP VP

NP ⟶ (D) A* N PP*

VP ⟶ V (NP) (PP)

PP ⟶ P NP

LEXICON

D: the, some

A: big, brown, old

N: birds, fleas, dog, hunter, I

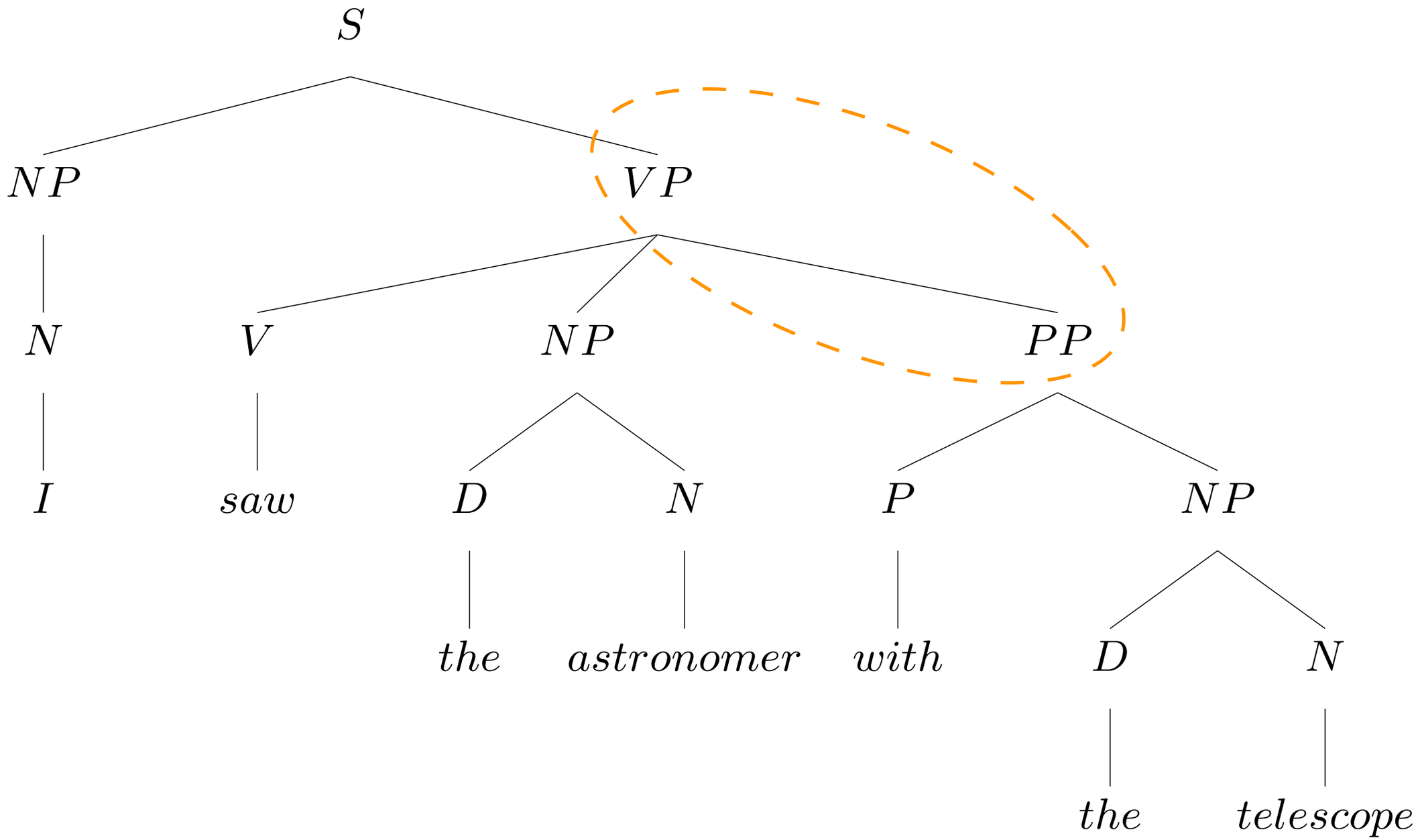
V: attack, ate, watched

P: for, beside, with

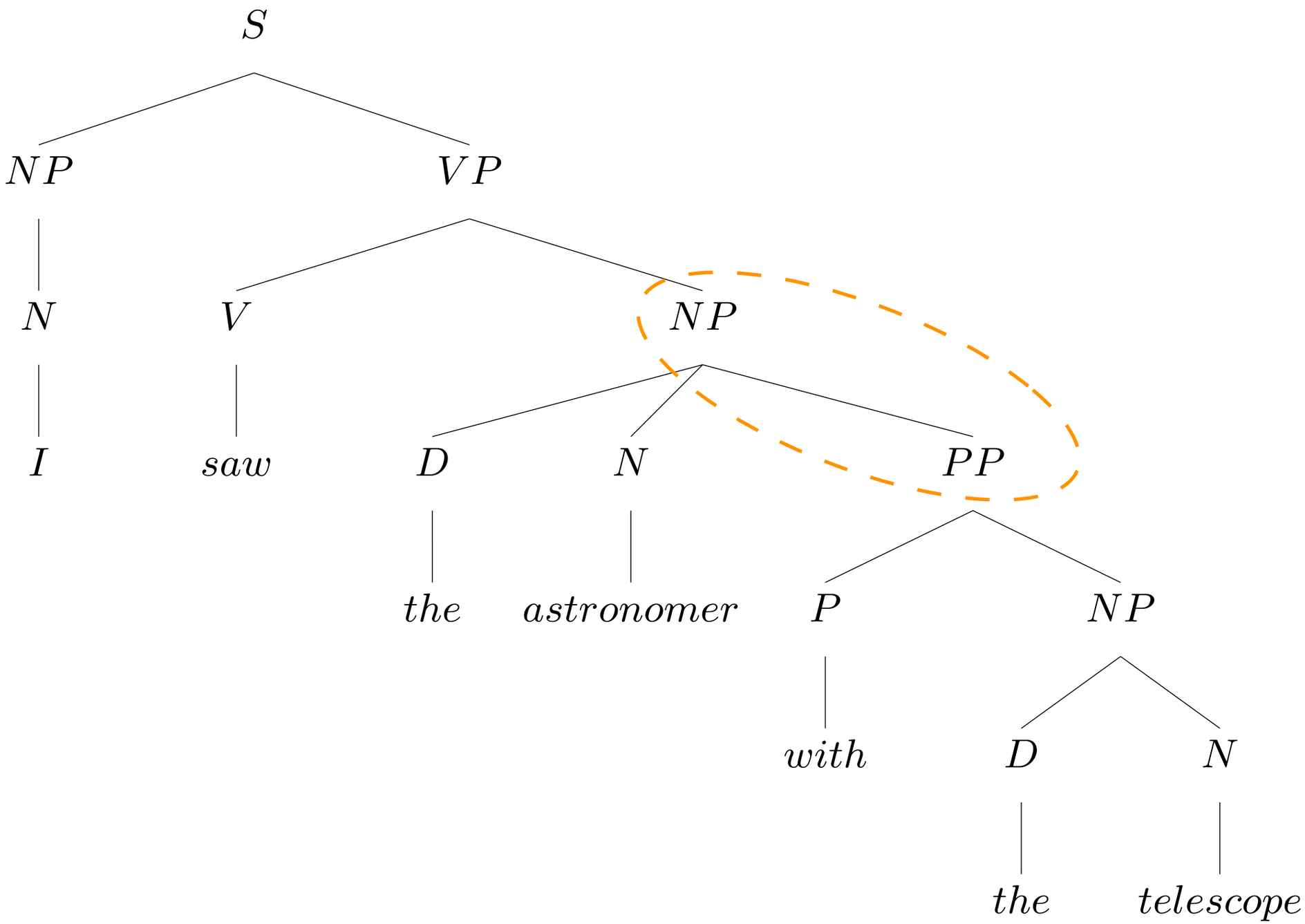
Structural Ambiguity

I saw the astronomer with the telescope.

Structure 1: PP under VP



Structure 1: PP under NP



Constituency Tests

- Recurrent Patterns

  The quick brown fox with the bushy tail jumped over the lazy brown dog with one ear.

- Coordination

  The quick brown fox with the bushy tail and the lazy brown dog with one ear are friends.

- Sentence-initial position

  The election of 2000, everyone will remember for a long time.

- Cleft sentences

  It was a book about syntax they were reading.

General Types of Constituency Tests

- Distributional
- Intonational
- Semantic
- Psycholinguistic

... but they don’t always agree.

Central claims implicit in CFG formalism:

1. Parts of sentences (larger than single words) are linguistically significant units, i.e. phrases play a role in determining meaning, pronunciation, and/or the acceptability of sentences.

2. Phrases are contiguous portions of a sentence (no discontinuous constituents).

3. Two phrases are either disjoint or one fully contains the other (no partially overlapping constituents).

4. What a phrase can consist of depends only on what kind of a phrase it is (that is, the label on its top node), not on what appears around it.

- Claims 1-3 characterize what is called ‘phrase structure grammar’

- Claim 4 (that the internal structure of a phrase depends only on what type of phrase it is, not on where it appears) is what makes it ‘context-free’.

- There is another kind of phrase structure grammar called ‘context-sensitive grammar’ (CSG) that gives up 4. That is, it allows the applicability of a grammar rule to depend on what is in the neighboring environment. So rules can have the form A $\rightarrow$X, in the context of Y_Z.

Possible Counterexamples

- To Claim 2 (no discontinuous constituents):

  A technician arrived who could solve the problem.

- To Claim 3 (no overlapping constituents):

  I read what was written about me.

- To Claim 4 (context independence):

  - *He arrives this morning.*
  - **He arrive this morning.*
  - **They arrives this morning.*
  - *They arrive this morning.*

A Trivial CFG

S $\longrightarrow$ NP VP

NP $\longrightarrow$ D N

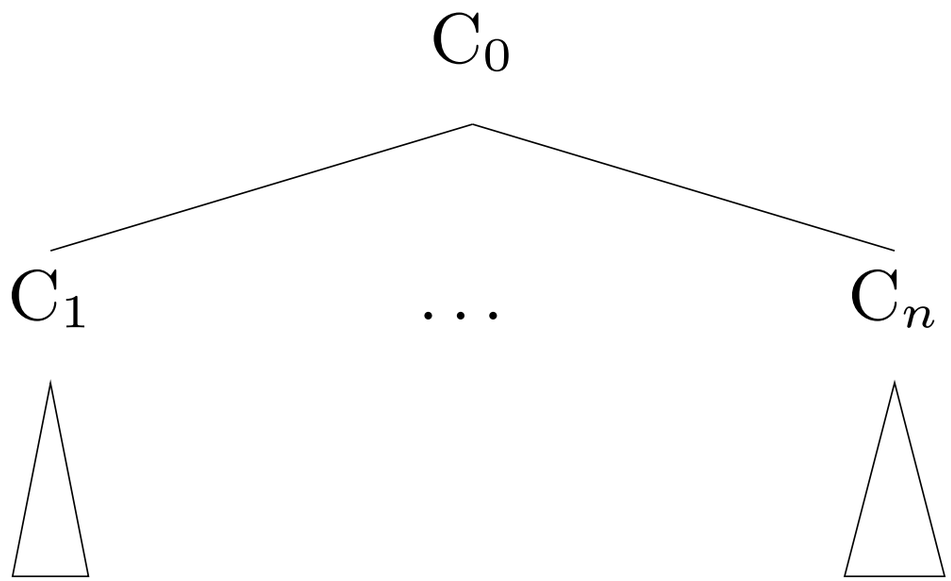
VP $\longrightarrow$ V NP

D: *the*

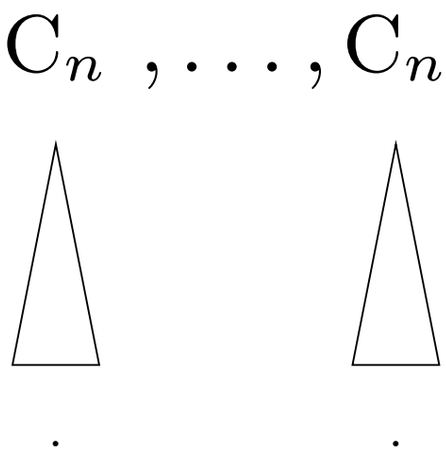
V: *chased*

N: *dog, cat*

Trees and Rules



is a well-formed nonlexical tree if (and only if)

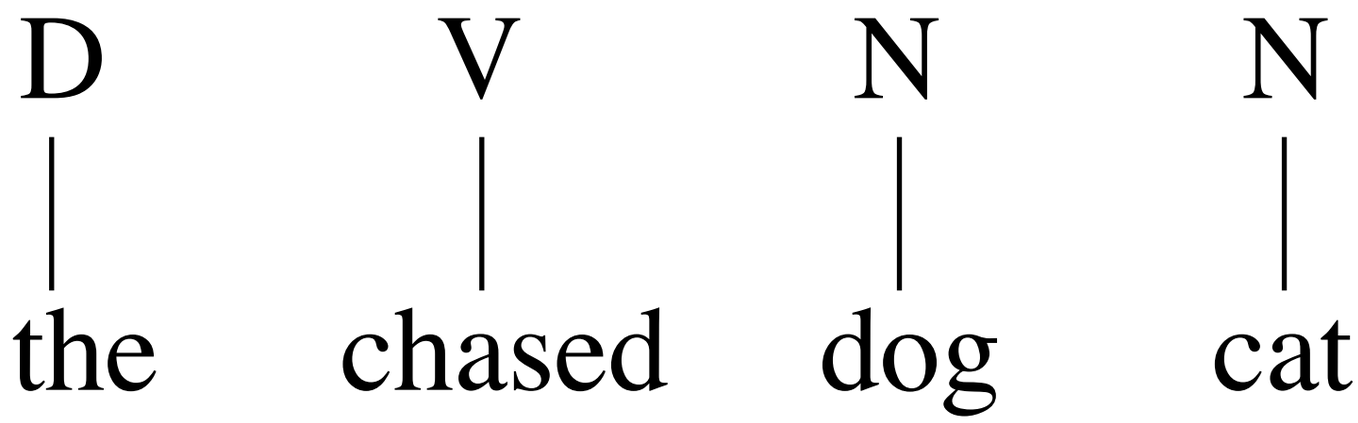


are well-formed trees, and

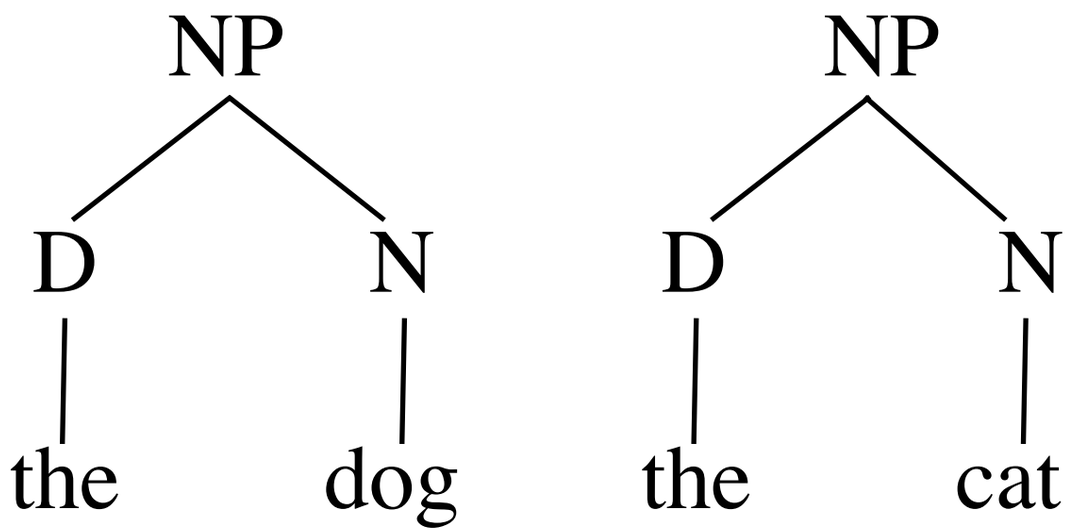
$C_0 \rightarrow C_1 \ldots Cn$ is a grammar rule.

Bottom-up Tree Construction

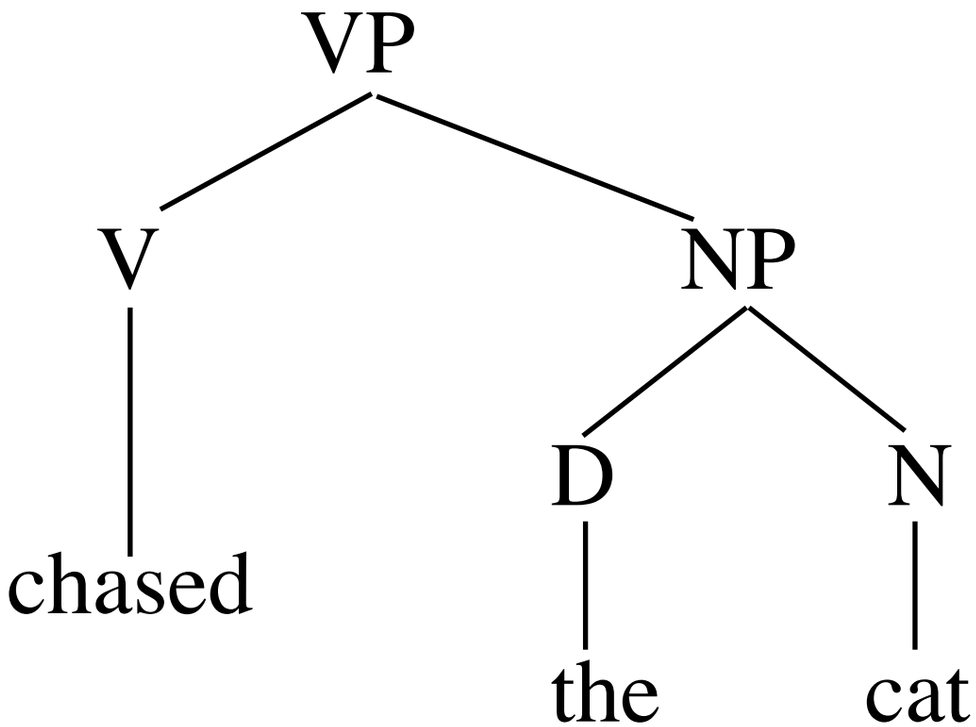
D: *the*
V: *chased*
N: *dog, cat*



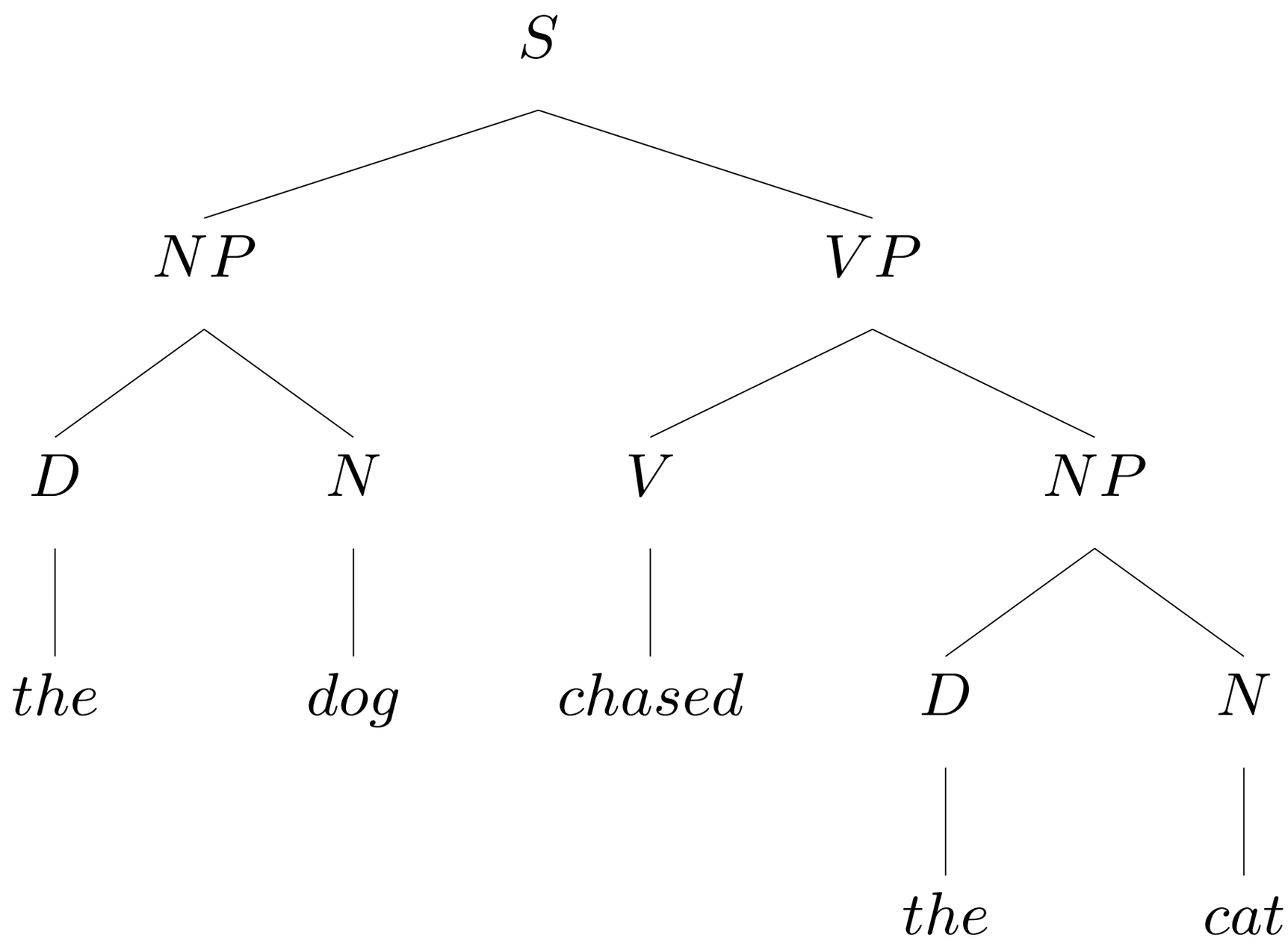
NP ⟶ D N



VP ⟶ V NP

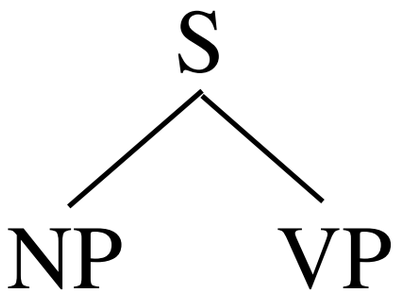


$$\text{S} \longrightarrow \text{NP VP}$$

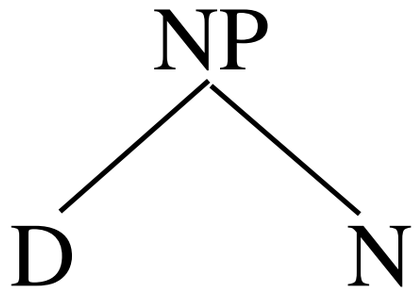


Top-down Tree Construction

$S \longrightarrow NP\ \ VP$

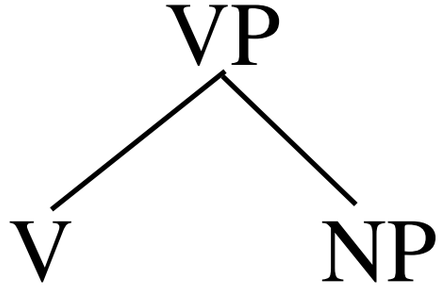


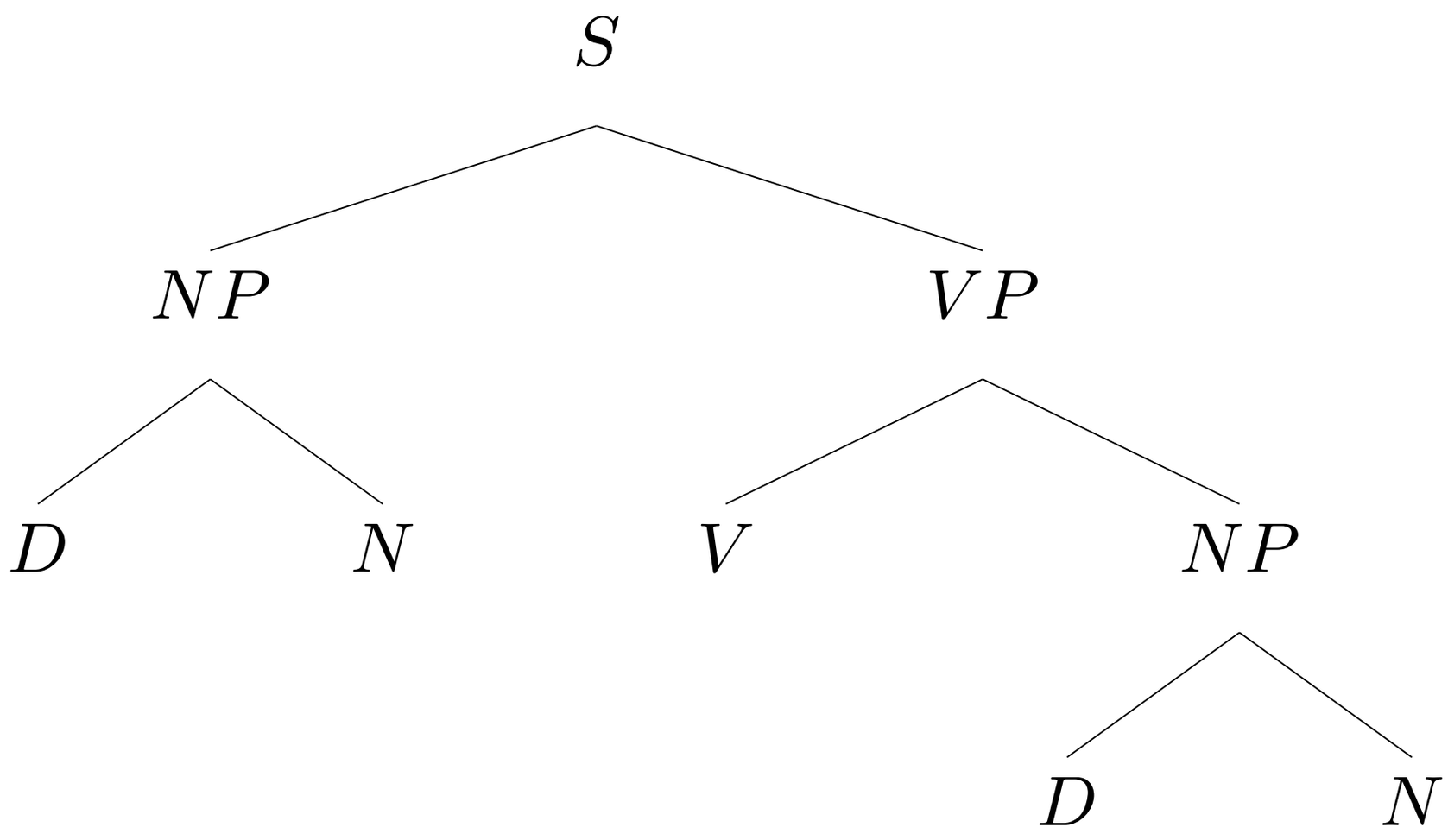
$NP \longrightarrow D\ \ N$

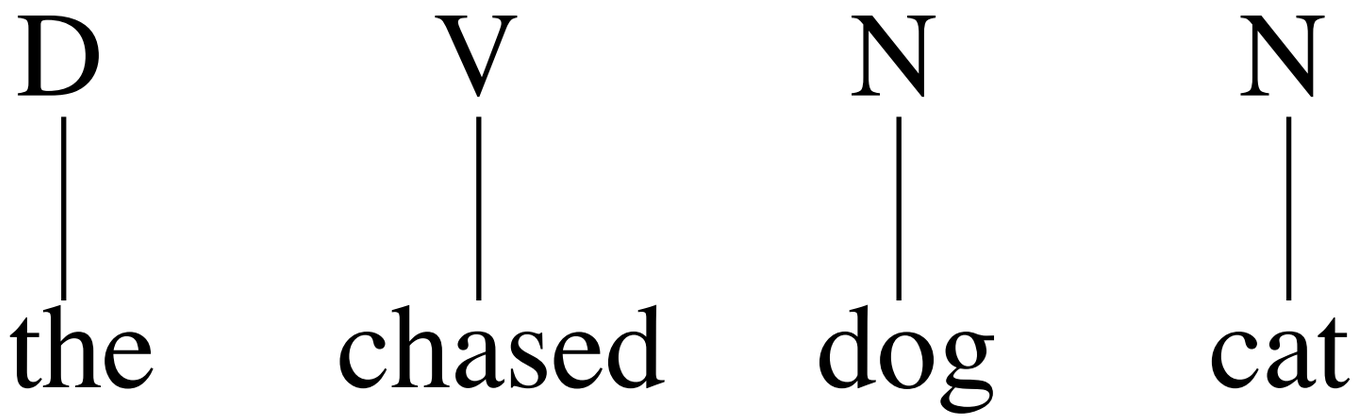


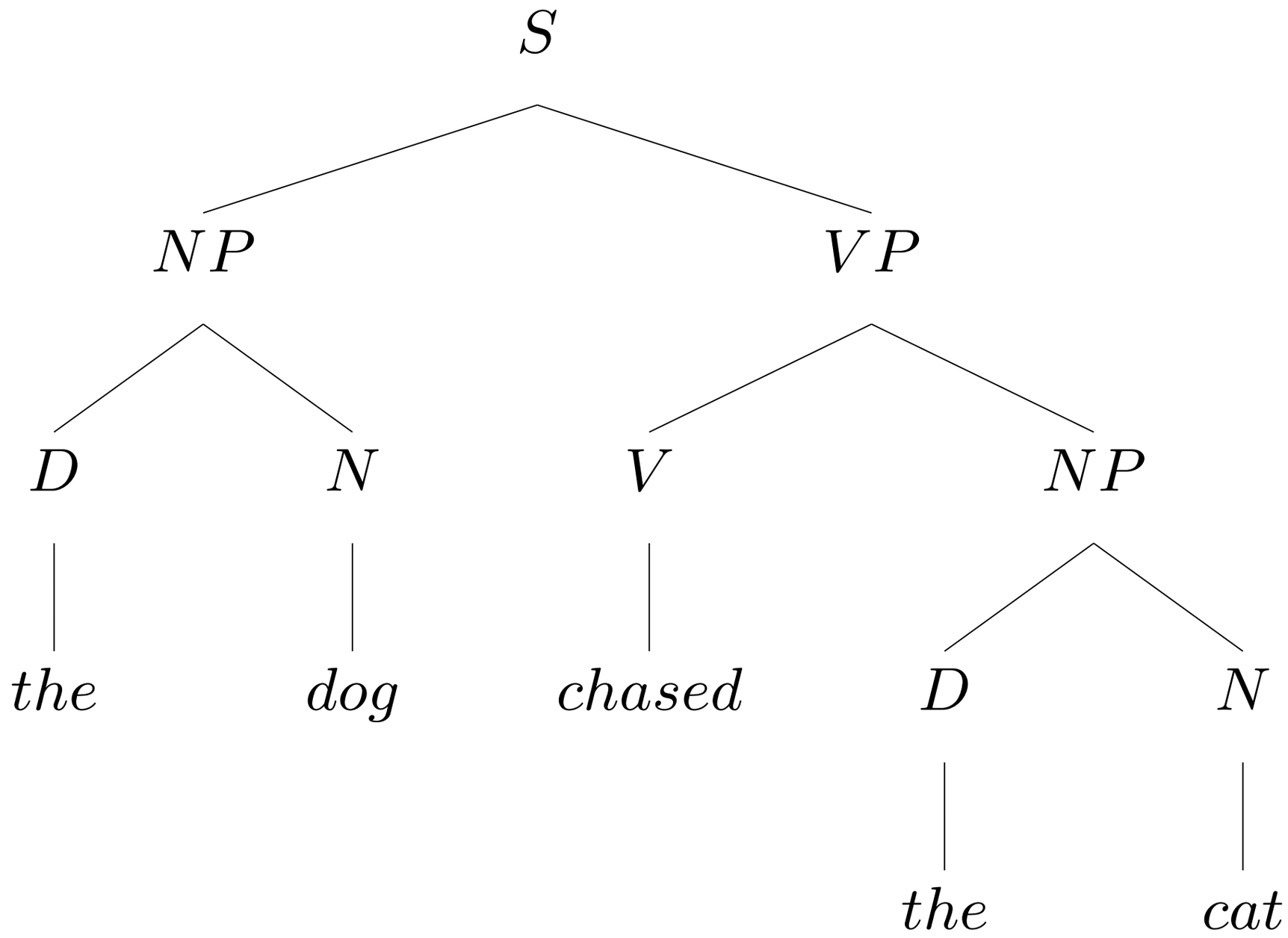
(twice)

$VP \longrightarrow V\ \ NP$




S
NP
VP
D
N
V
NP
D
N


D V N N
the chased dog cat


S
NP
VP
D
N
V
NP
the
dog
chased
D
N
the
cat

Bottom-up and top-down approaches are equivalent for CFG, but can differ for more complex types of grammars

Rules

S ⟶ A B

A ⟶ C D, in the environment __E.

B ⟶ E F, in the environment D__.

Lexicon

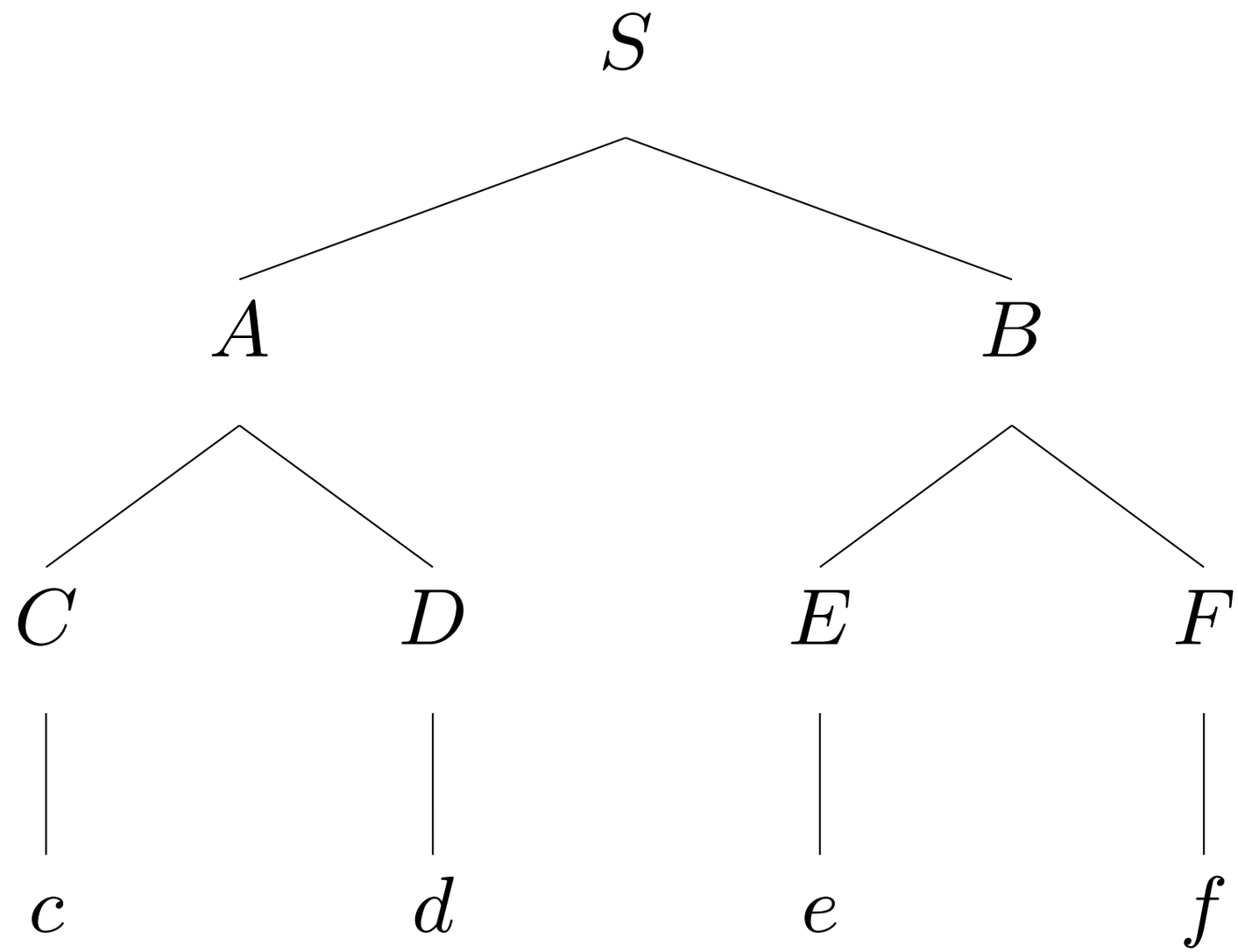
C: c

D: d

E: e

F: f

This tree is licensed bottom-up, but not top-down



Weaknesses of CFG

- It doesn't tell us what constitutes a linguistically natural rule

  $VP \rightarrow P\ NP$

  $NP \rightarrow VP\ S$

- Rules get very cumbersome once we try to deal with things like agreement and transitivity.

- It has been argued that certain languages (notably Swiss German and Bambara) contain constructions that are provably beyond the descriptive capacity of CFG.

On the other hand....

- It's a simple formalism that can generate infinite languages and assign linguistically plausible structures to them.
- Linguistic constructions that are beyond the descriptive power of CFG are rare.
- It's computationally tractable and techniques for processing CFGs are well understood.

So.....

- CFG has been the starting point for most types of generative grammar.
- The theory we develop in this course is an extension of CFG.

Overview

- Syllabus
- Prescriptive/descriptive grammar; Competence/performance
- Some history
- Why study syntax?
- Two theories that won't work
- CFG
- Next week: Feature structures