Constituency, Trees and Rules

COURSE: ADVANCED SYNTAX AND MORPHOLOGY

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Introduction

- Syntax is the study of the rules governing the way words are combined to form sentences in a language.
  - *garden the
  - *Children are
  - *Work in
- This class: *what syntactic structure is and what the rules that determine syntactic structure are like.*

Syntax

- Properties of syntactic knowledge:
  1. *Humans can understand & produce an infinite number of sentences they never heard before*

     "Some purple gnats are starting to tango on microwave"
  2. *Our grammar can understand and produce long sentences*
     - "Bill said that he thought that the esteemed leader of the house had it in mind to tell the unfortunate vice president that the calls that he made from the office in the White House that he thought was private….."
  3. *It enables us determine the grammatical relations in a sentence*

     Mary hired Bill. Vs. Bill hired Mary

Syntax & meaning

- Non-sense sentences with clear syntax
  - Colorless green ideas sleep furiously.
  - A verb crumpled the milk.
  - I gave the question a scuba-diving egg.

  As opposed to:
  - *Furiously sleep ideas green colorless.
  - *Milk the crumpled
  - *the question I an egg scuba-diving gave.

- Sentences are composed of discrete units that are combined by rules. These rules explain how speakers can store infinite knowledge in a finite space- brain.

Generative Grammar

- Noam Chomsky 1950s
- *Generative* = a very explicit system of rules specifying what combinations of basic elements result in well-formed sentences.

- Defines the syntactic structure of a language.

Generative Grammar

- Must allow all and only the grammatical sentences in a language
- Descriptive rules, not necessarily prescriptive
- Each rule “rewrites” a constituent into one or more constituents

Generative Grammar

- "all and only"= all grammatical sentences and only grammatical sentences
- Finite rules→infinite number of well-formed sentences
- Productivity of language:
  - Phrase structure rules
  - Transformational rules

Constituent

- A constituent is a string of words that function as a unit .
- Constituents are embedded one inside another to form larger constituents in a **hierarchical structure**.
- This hierarchical structure is presented in **tree structures** .

Phrasal Categories

- **S (TP)**: Sentence (tense phrase)
- **NP**: Noun Phrase (subject of the sentence)
- **VP**: Verb Phrase (predicate of the sentence)
- **PP**: Prepositional Phrase
- **AdjP**: Adjective Phrase
- **AdvP**: Adverb Phrase

Phrase Structure Rules

Rules that determine:

- what goes into a phrase ('constituents')
- how the constituents are ordered

Each rule "rewrites" a constituent into one or more constituents

Phrase Structure Rules

- are generative, allow recursion.
- give different analyses of syntactically ambiguous sentences.
- have a hierarchical structure.

Phrase Structure Rules

- Examples – structure of the English noun phrase(NP)

NP → (Det) (Adj) **N** (PP)

The unopened books on the table

So NP must contain a NP but can also contain a lot of other phrases.

Phrase Structure Rules

- Examples- structure of the verbal phrase (VP)
  - VP → V shouted
  - VP → V Adv shouted happily
  - VP → V NP kick the ball
  - VP → V NP PP (Adv) put the book on the desk(quietly)
  - VP → V (S) know (the students attended their lectures)

So, a VP must contain a verb, but can also contain a lot of other phrases (…): VP → V (NP) (PP)(Adv) (S)

Phrase structure rules

Sentence/Clause-level PS Rules

1. **S → NP VP** (a sentence is obligatorily comprised of a NP and a VP)

[**NP** The students] [**VP** attended their lectures]

2. **S → NP (Aux) VP**

The students will take exams.

A sentence must contain NP and VP, the auxiliary is optional, we can indicate this with (…).

Phrase structure rules

- S ⟶ {NP/CP} (T) **VP**
- VP ⟶ (AdvP+) **V** (NP)({NP/CP}) (AdvP+) (PP+) (AdvP+)
- NP ⟶ (D) (AdjP+) **N** (PP+) (CP)
- PP ⟶ **P** (NP)
- AdjP ⟶ (AdvP) **Adj**
- AdvP ⟶ (AdvP) **Adv**
- CP ⟶ (C) **S**

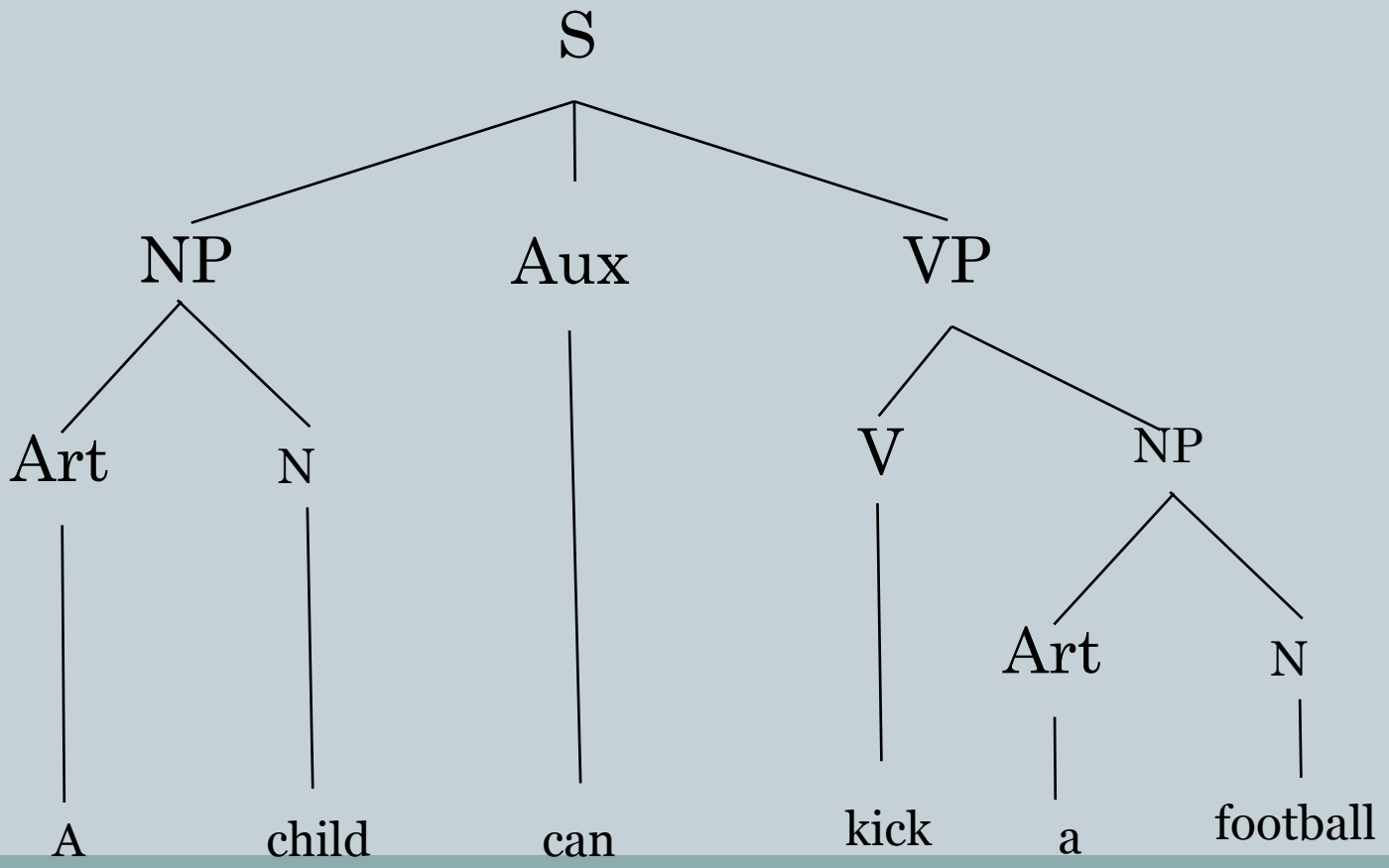
The items in red are obligatory in the constituent. They are the heads that give each category its name.

What is Tree Diagram?

- Tree diagram provides us visual representation of the constituents of the corresponding expression.

What is Tree Diagram?

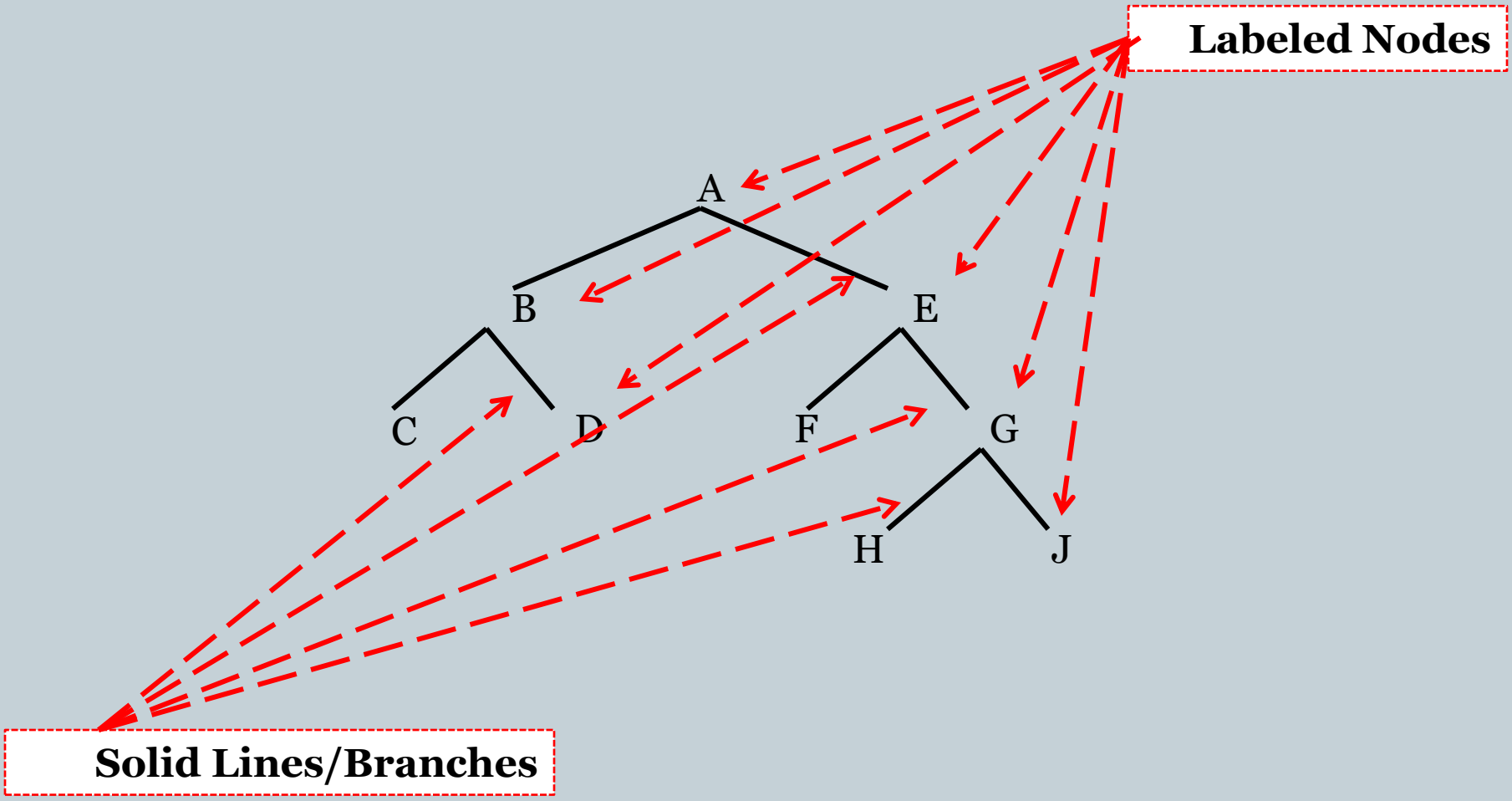
- E.g. A child can kick a football.



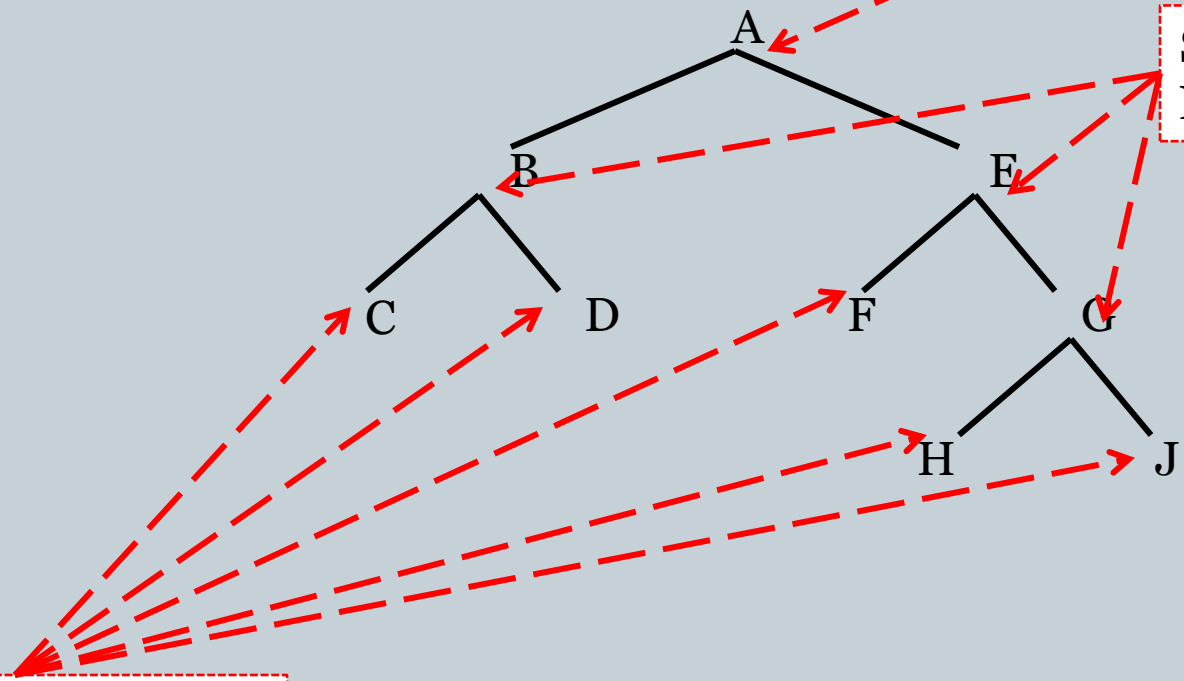
Tree Diagram Terminology

- Constituent
- Sub-Constituent
- Root/Mother, Sister, Daughter, Grand Daughter, etc.
- Node, Terminal Node, Non-terminal Node, Labeled Node
- Branch/Solid Line

Tree Diagram Terminology



Tree Diagram Terminology



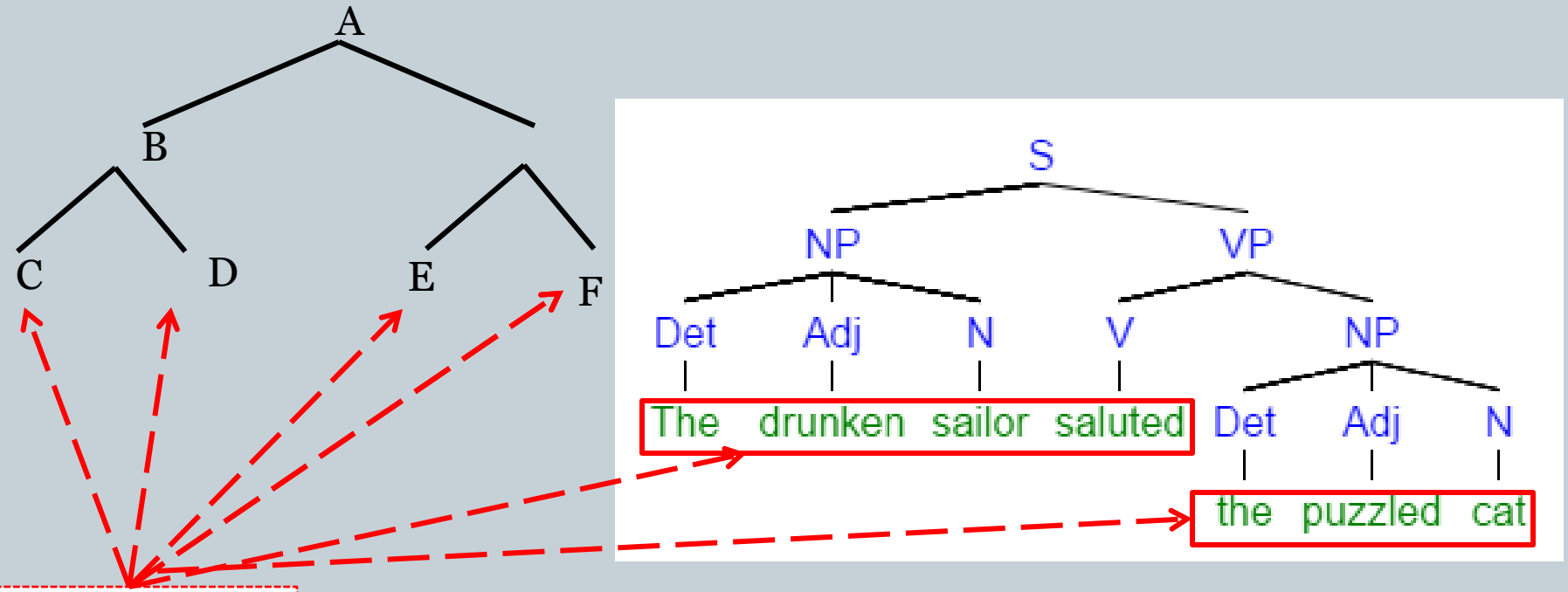
Constituent
Non-Terminal Node

Sub-Constituent
Non-Terminal Node

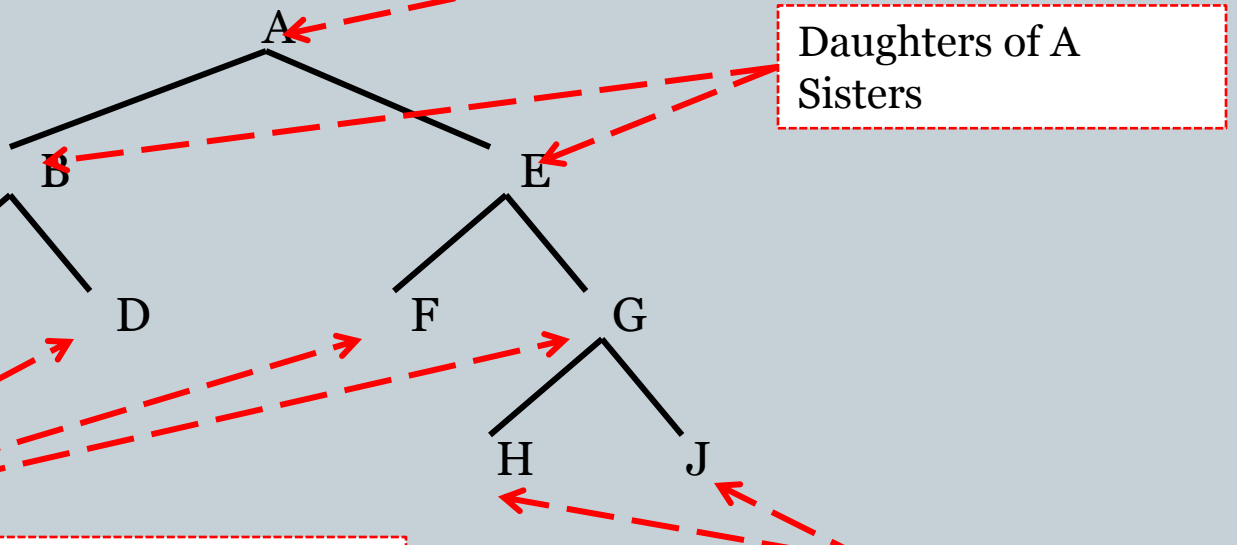
Terminal Nodes

Terminal Nodes contain any lexical item❖

Tree Diagram Terminology



Tree Diagram Terminology



•Grand Daughters of A
•Sisters—CD (daughters of B) and FG(daughters of E)
•Cousins CD to FG and FG to CD

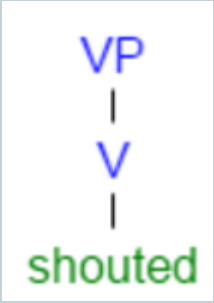
•Daughters of G
•Sisters to each other
•They have no cousin
•Grand grand daughters of A
•Grand daughters of E

Syntactic Trees and Phrases

- Every sentence in the language has its representation in syntactic trees.
- Consider the following examples of verbal phrases:
  - VP → V shouted
  - VP → V Adv shouted happily
  - VP → V NP kick the ball
  - VP → V NP PP (Adv) put the book on the desk(quietly)
  - VP → V (S) know (the students attended their lectures)

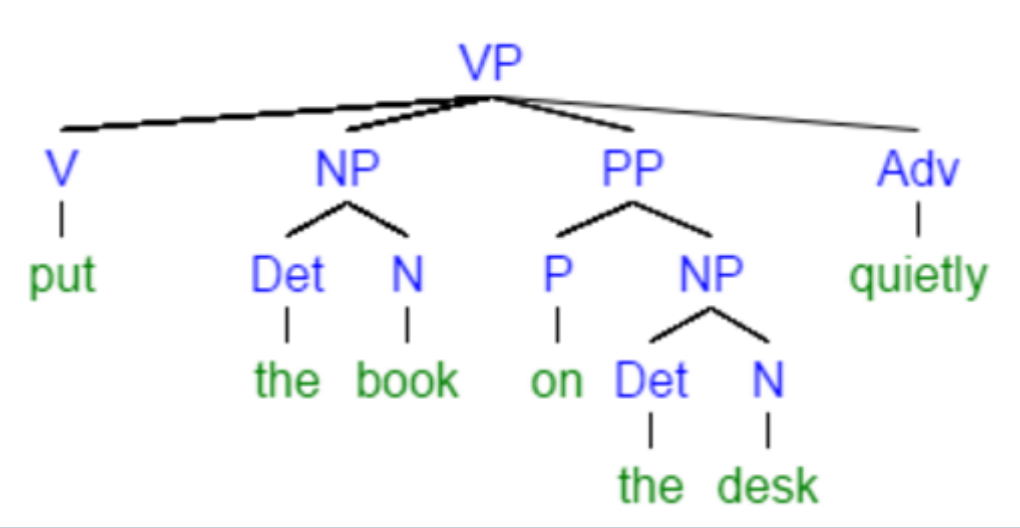
Syntactic Trees and Phrases

- VP → V shouted
- It consists of only a verb, thus:
- [VP [V shouted]]
- This is presented in the following tree:



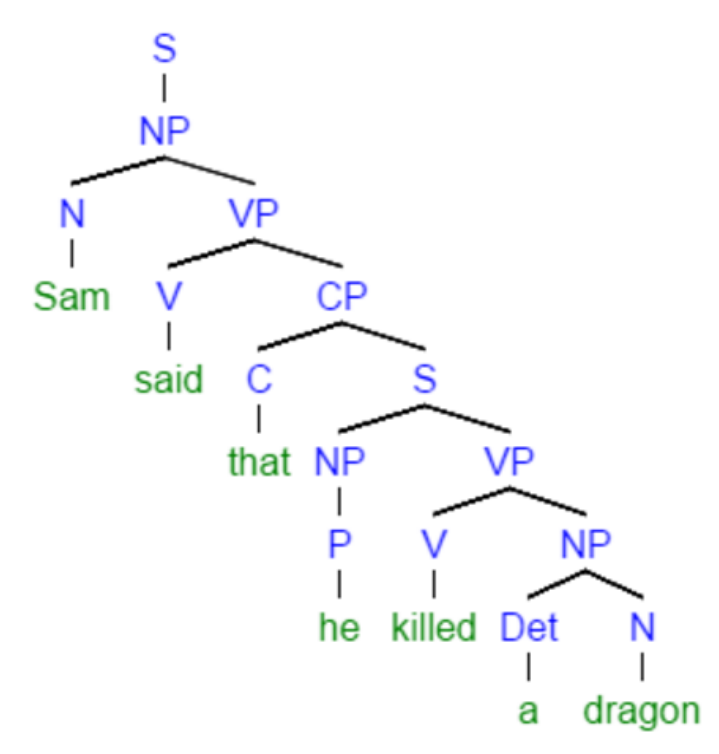
Syntactic Trees and Phrases

- Now another verbal phrase with more than one word
- VP → V NP PP (Adv) put the book on the desk(quietly)
- [VP[V put][NP[Det the][N book]][PP[P on][NP[Det the][N desk]]][Adv quietly]]
- And we thus have the following tree:



- Clauses don’t always have to stand on their own. There are times when one clause is embedded inside another:

- E.g. Sam said that he killed a dragon
- [S [NP[N Sam] [VP[V said] [CP [C that] [S[NP[P he]][VP[V killed][NP[Det a][N dragon]]]



Recursion

- Rules can be applied more than once in generating sentences
- E.g. repeat prepositional phrase more than once
  - The apple was on the bench near the stove in the kitchen of the haunted house
- Put sentences inside sentences
  - This is the cat *that* ate the rat *that* ate the cheese *that* was sold by the woman *that* lived in the village *that* was by the river…
- No end to recursion- produce longer complex sentences

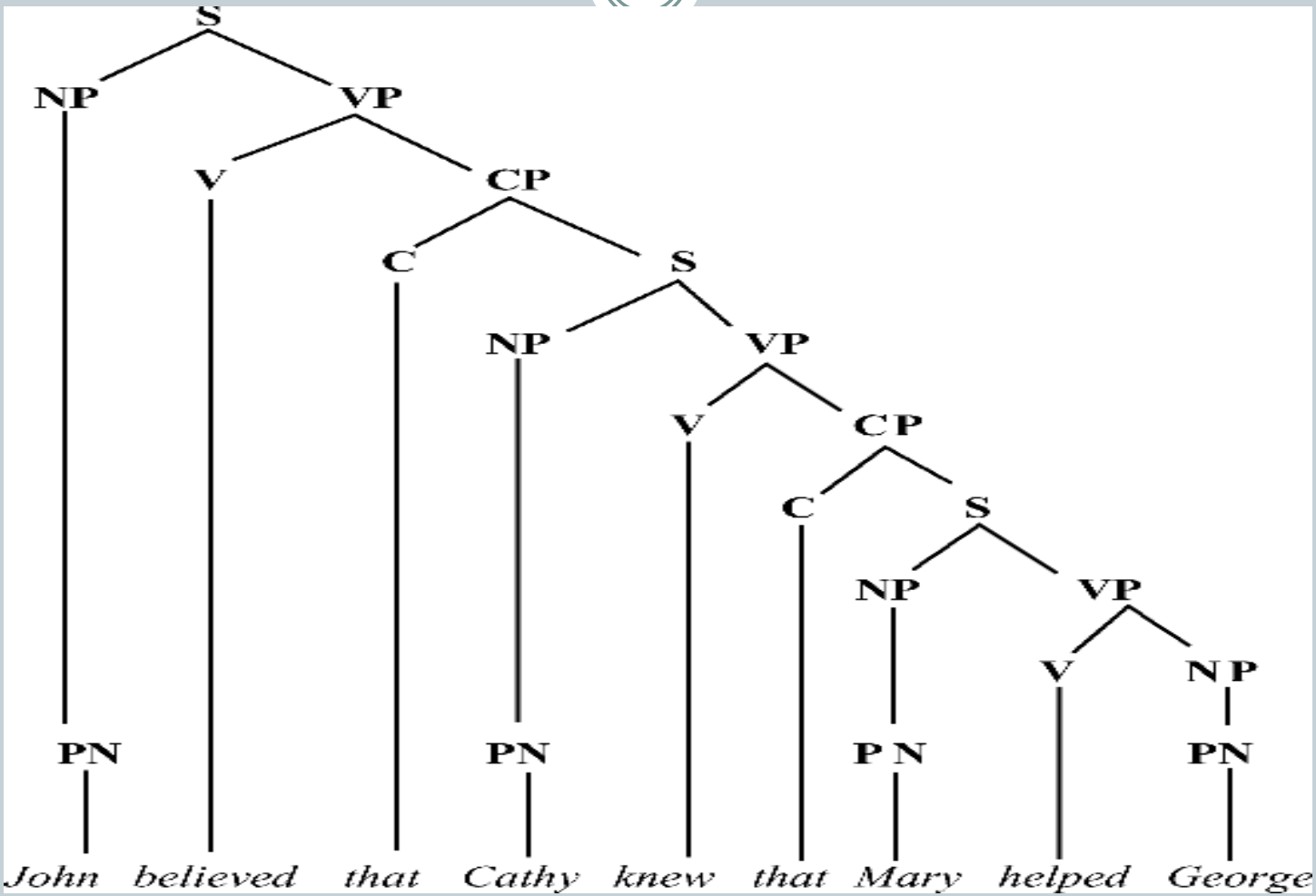
Recursion

- [Mary helped George]. (A sentence)
- [Cathy knew] that [Mary helped George].
  (a sentence within a sentence)
- [John believed] that [Cathy knew] that [Mary helped George].
- The word *that* introduces the **complement phrase**

Complement Phrases

- Cathy knew *that* Mary helped George
- That = complementizer (C) introducing **complement phrase (CP)**
- The CP comes after the VP
- S ⟶ NP VP
- VP⟶V CP
- CP⟶ C S

Complement Phrases



How to Draw Trees

- There are actually two ways to go about drawing a tree.
- You can start at the bottom and work your way up to the **S**, or you can start with the **S** moving down to the terminal nodes

How to Draw Trees

- E.g. The very cute baby kissed the nurse on the cheek.

- Since we will draw a bottom-up tree, it is a good idea to move the sentence to the bottom of the page so that we have enough space for nodes and arrows.

How to Draw Trees

The very cute baby kissed the nurse on the cheek.

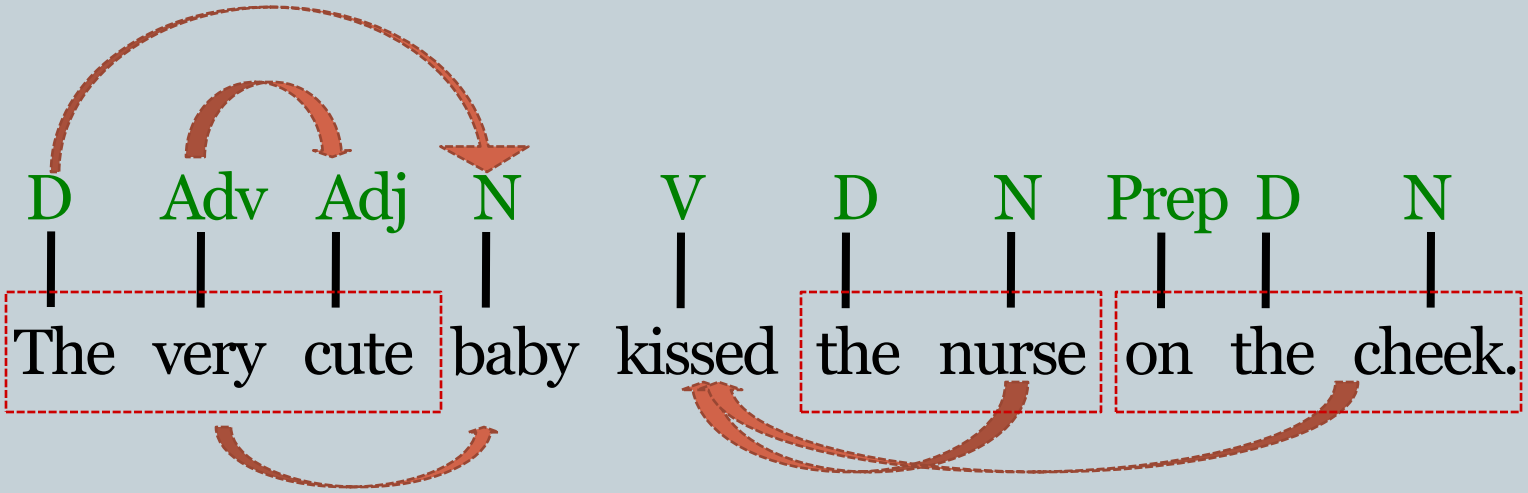
How to Draw Trees

Step 1: Identify parts of speech:

D	Adv	Adj	N	V	D	N	Prep	D	N
The	very	cute	baby	kissed	the	nurse	on	the	cheek.

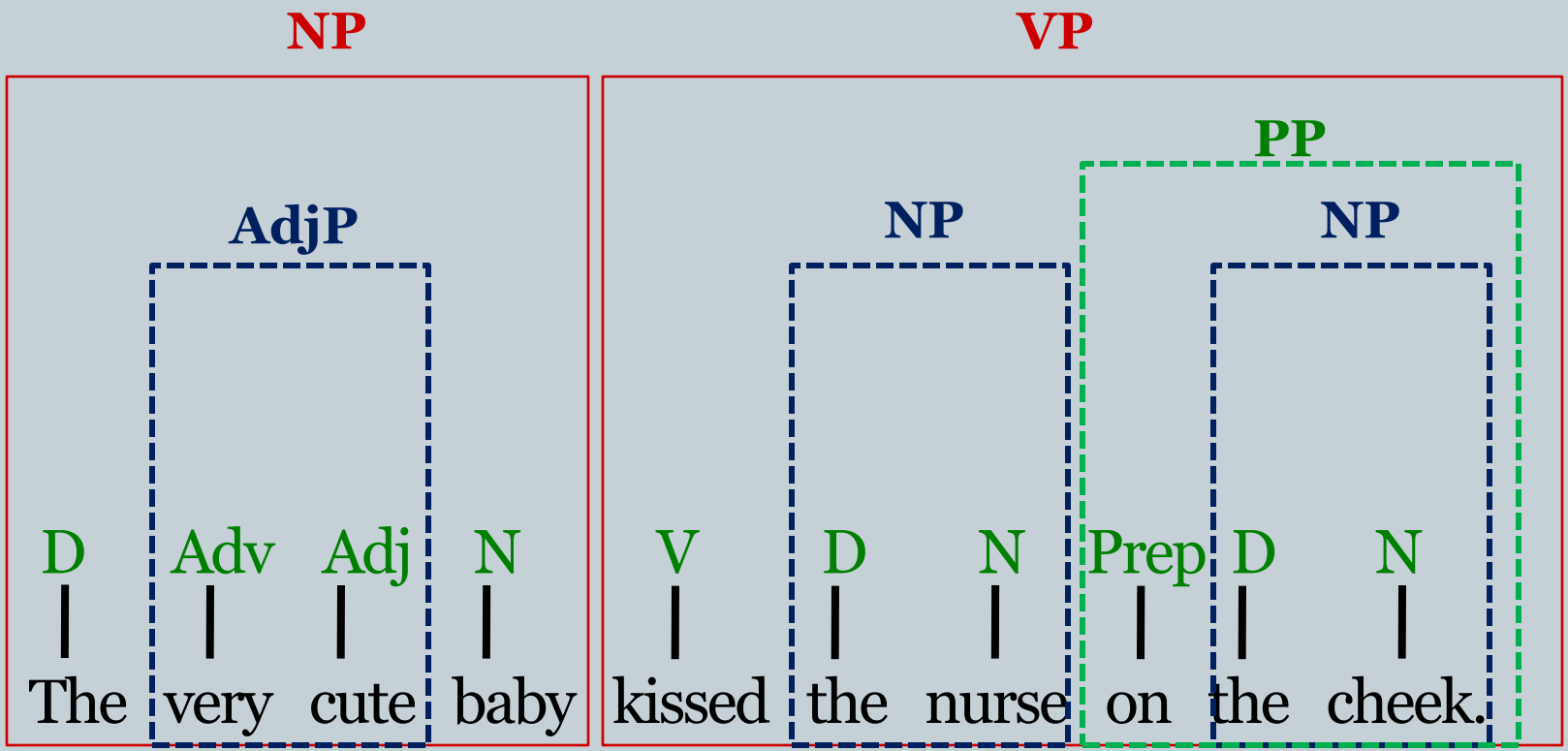
How to Draw Trees

Step 2: Identify what modifies what:



How to Draw Trees

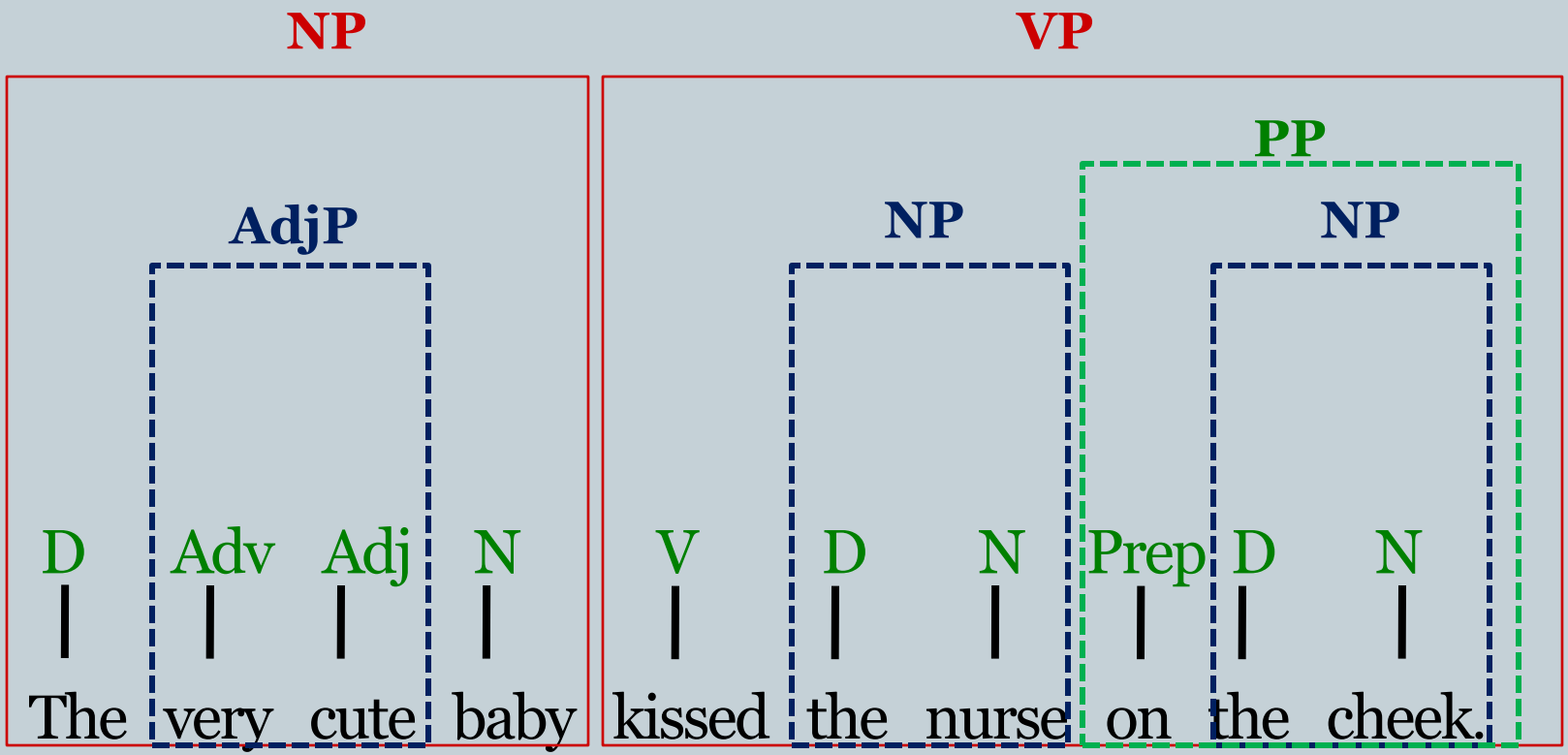
Step 3: start linking together items that modify one another:



How to Draw Trees

Step 4: make sure you apply the rule **exactly** as it is written, e.g.:

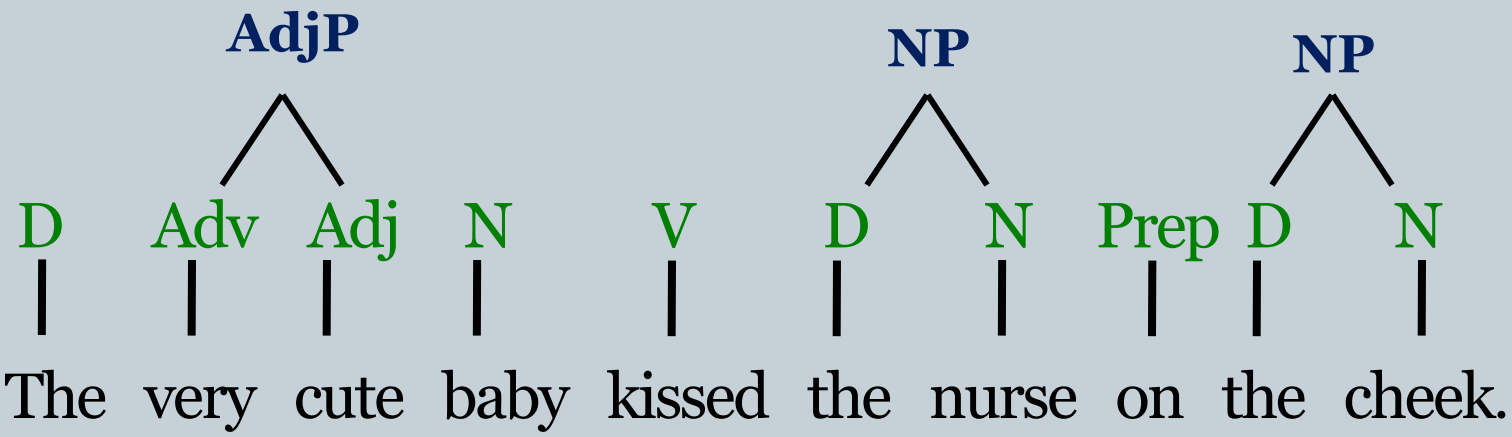
AdjP → (AdvP) Adj



How to Draw Trees

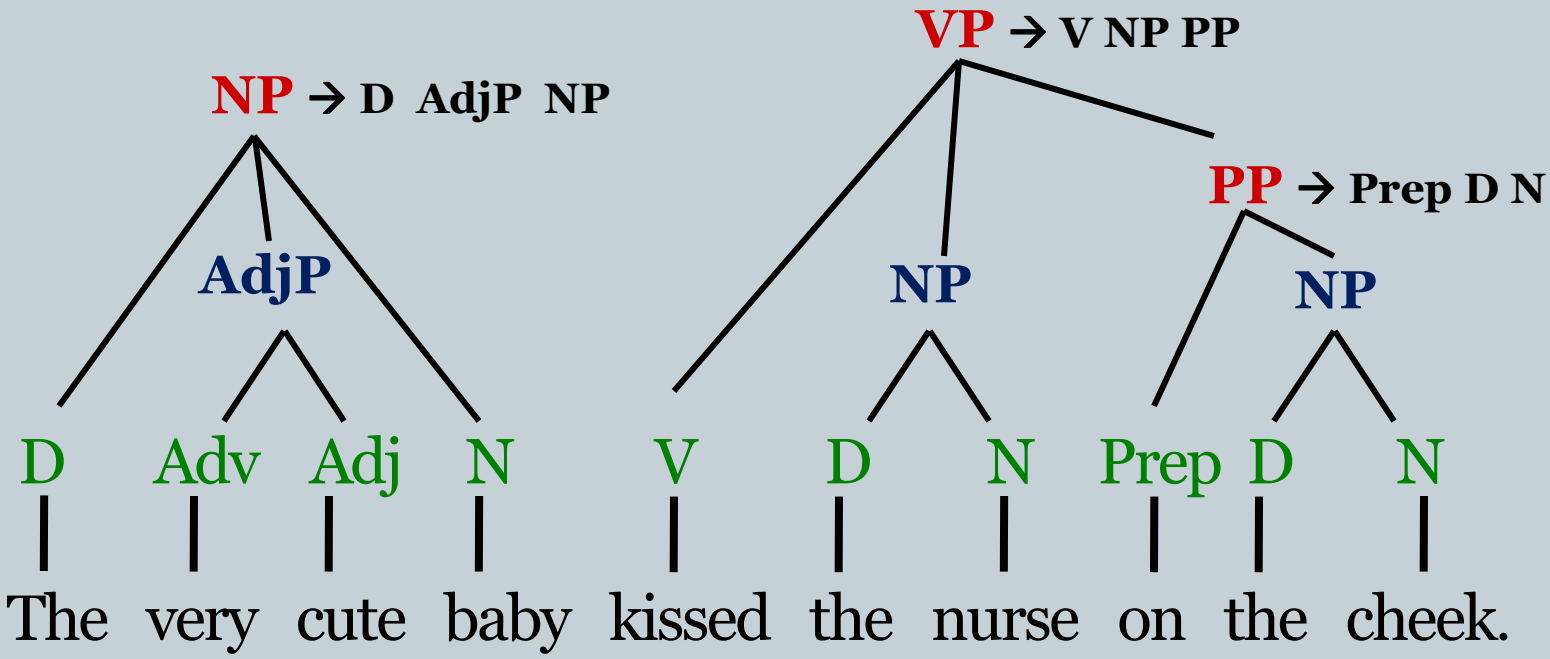
Step 5: make sure you apply the rule **exactly** as it is written, e.g.:

AdjP → (AdvP) Adj



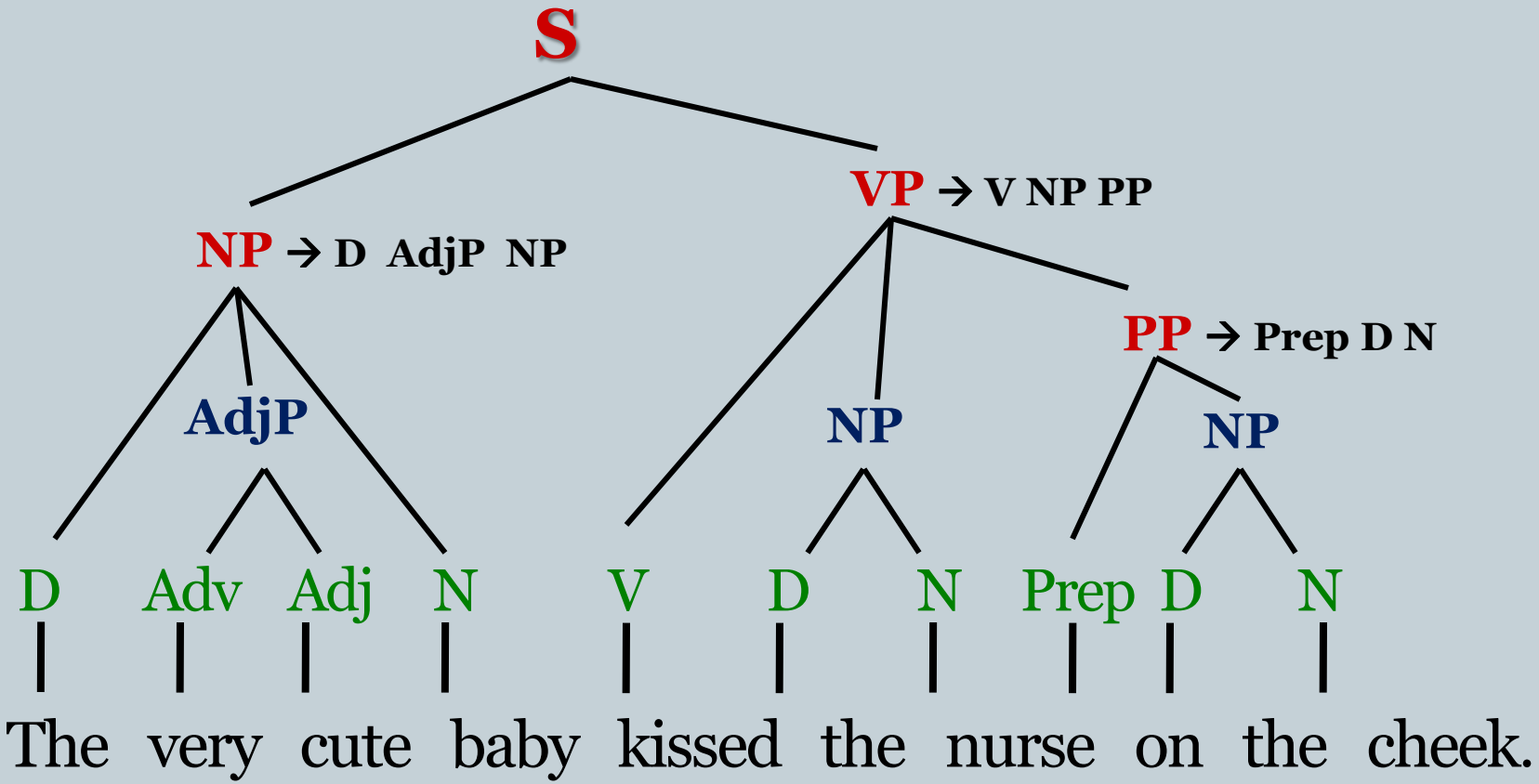
How to Draw Trees

Step 6: Keep applying the rules until you have attached all the modifiers to the modified constituents:



How to Draw Trees

Step 7: when you have built up the NP and VP, apply the S rule:



How to Draw Trees

Some important considerations:

1. Make sure that everything is attached to the tree.
2. Make sure that every category has only *one* line immediately on top of it (it can have more than one under it, but only one immediately on top of it).
3. Don't cross lines.
4. Make sure all branches in the tree have a part of speech label.
5. Avoid triangles.

Deep and Surface Structure

- ***The deep structure*** is an abstract level of structural organization in which all the elements determining structural interpretation are represented.
  - Sentences that have alternative interpretations
  - Sentences that have different surface forms but have the same underlying meaning.
- ***Surface structure***= how the sentence is actually represented

Deep and Surface Structure

- How superficially different sentences are closely related?
  - Charlie broke the window.
  - The window was broken by Charlie
  - Charlie who broke the window.
  - Was the window broken by Charlie?

  - *Difference in their surface structure* = difference in syntactic forms
  - *BUT they have the same 'deep' or underlying structure*

Structural ambiguity

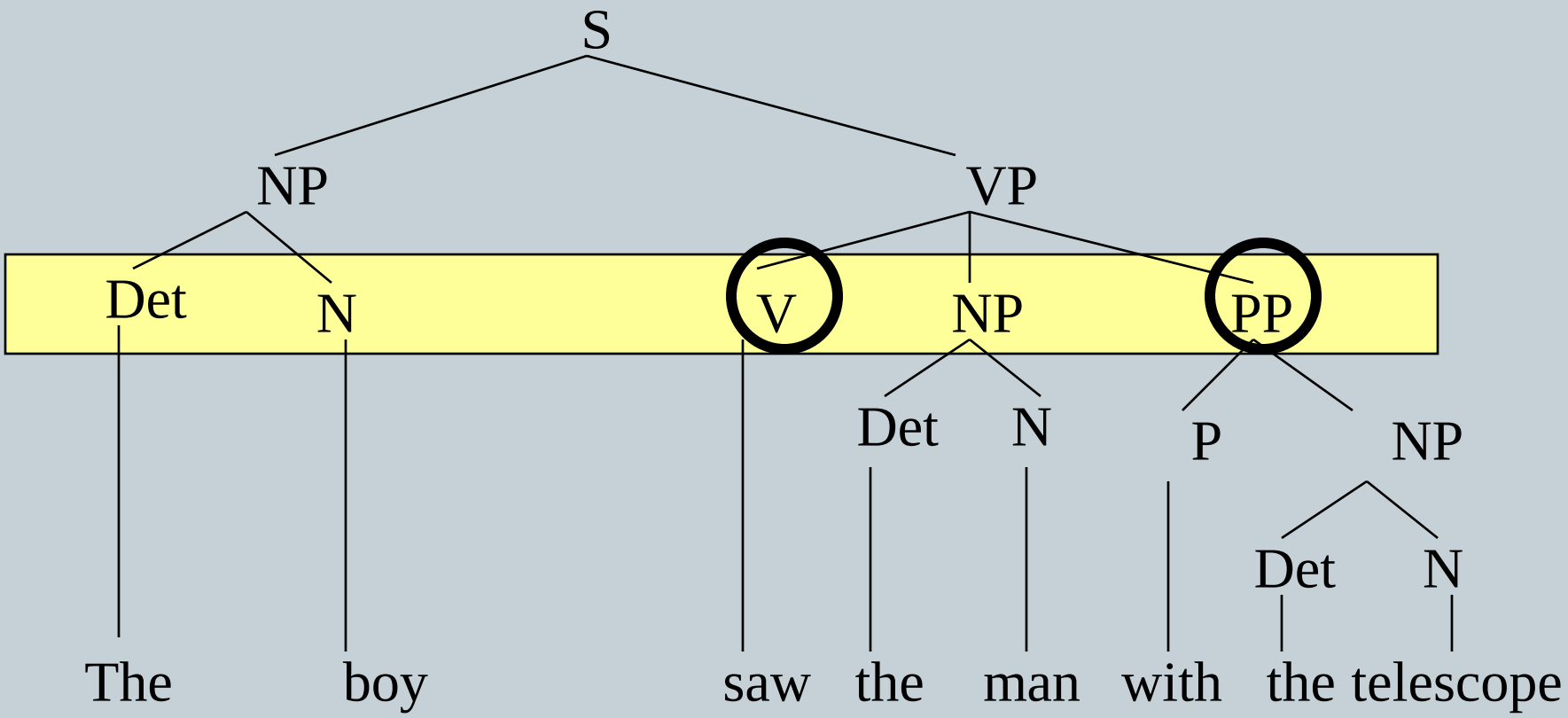
- How superficially similar sentences are different? *(multiple meanings)*
- E.g. Annie whacked the man with an umbrella
- *Same surface structure but different deep structure*
  - The boy saw the man with a telescope
- The question is: What is the scope of "with the telescope"? Does it modify only "the man" or does it modify "saw the man"?

Structural Ambiguity

- Syntactic trees allow us to capture another important fact about syntactic structure: Sentences often are ambiguous.
- This is done by referring to the Principle of Modification which states :
- ***Principle of Modification*** :If an XP (that is, a phrase with some category X) modifies some head Y, then XP must be a sister to Y (i.e., a daughter of YP).
- Consider the following example:

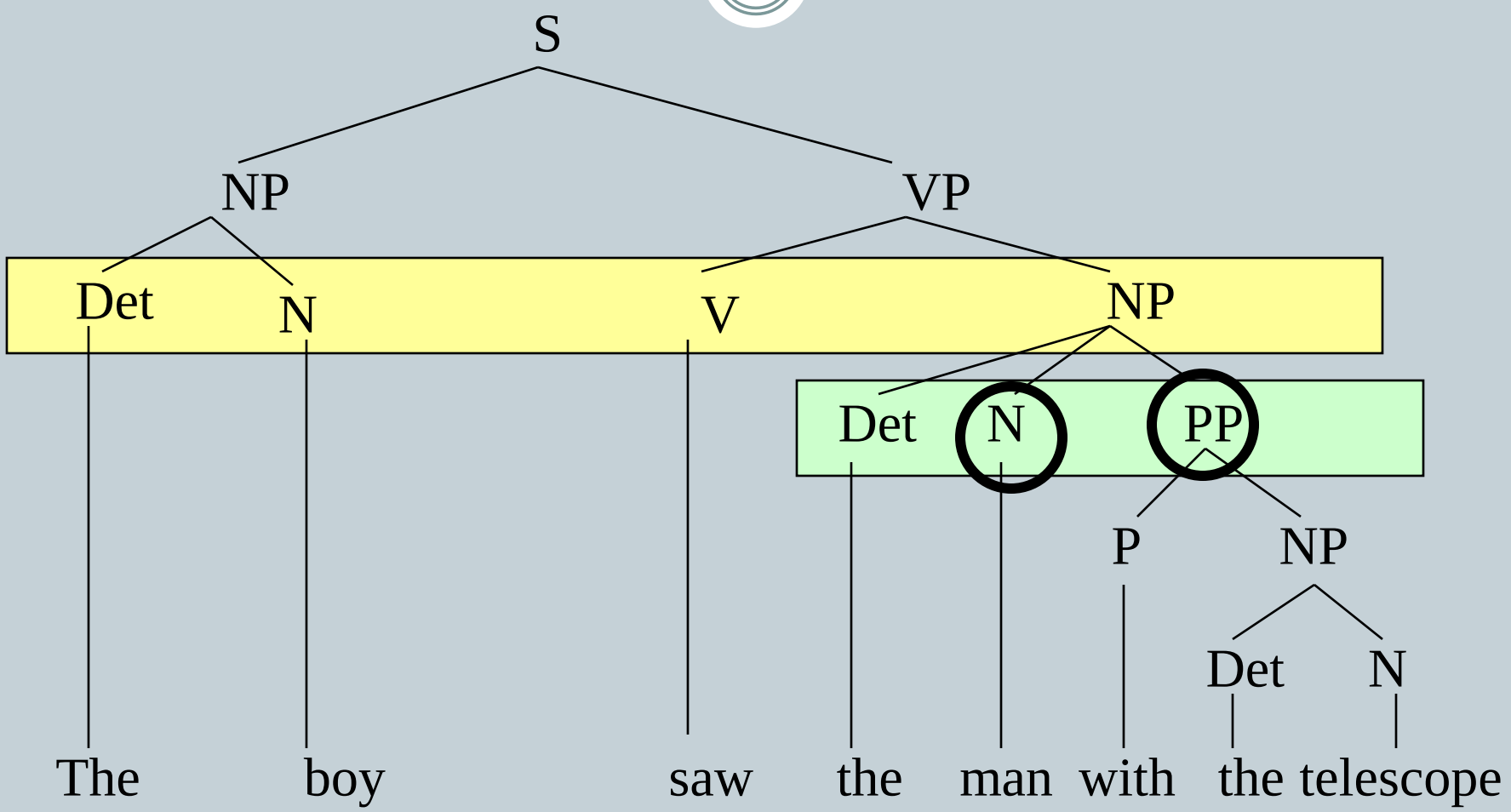
  The boy saw the man with the telescope.

Structural Ambiguity



Meaning: Using the telescope, the boy saw the man

Structural Ambiguity



Meaning: The boy saw the man. The man had a telescope.

Constituency Tests

- Constituents are generated by rules up to the light of the scientific method.
- If the hypothesis of constituency is correct, we should be able to test it in general.

Constituency Tests

- First, the smallest constituent is a single word, so it follows that if you can replace a group of words with a single word then we know that group forms a constituent.
- Consider the italicized NP in the following sentence, It can be replaced with a single word (in this case a pronoun).

This is the ***replacement*** test.

- a) *The man from NY* flew only ultra-light planes.
- *He* flew only ultra-light planes.

Constituency Tests

- The second test we will use is the ***stand-alone*** test (sometimes also called the ***sentence fragment*** test).
- If the words can stand alone in response to a question, then they probably constitute a constituent

Constituency Tests

- **Stand-alone test example:**

'Paul ate at a really fancy restaurant'

"What did Paul do yesterday afternoon?"

Ate at a really fancy restaurant (VP)

"Where did Paul eat yesterday afternoon?"

at a really fancy restaurant (PP)

Constituency Tests

- ***Movement*** is our third test of constituency. If you can move a group of words around in the sentence, then they form a constituent – because you can move them as a unit.
- It is only reliable when you keep the meaning roughly the same as in the original sentence
- it involves putting the object in the subject position, the subject in a "by phrase" (after the word *by*) and changing the verb form (for example from *kiss* to *was kissed*).

Constituency Tests

Movement involves

1- Clefting:

It was [a brand new car] that he bought.
(from *He bought a brand new car*)

2- Preposing:

[Big bowls of beans] are what I like.
(from *I like big bowls of beans)*

3- Passive:

[The big boy] was kissed by [the slobbering dog].
(from *The slobbering dog kissed the big boy*)

Constituency Tests

- the test of ***coordination*** (also called ***conjunction***). Coordinate structures are constituents linked by a conjunction like *and* or *or*. Only constituents of the same syntactic category can be conjoined:

- a) [John] and [the man] went to the store.
- *John and very blue went to the store.
- If you can coordinate a group of words with a similar group of words, then they form a constituent.

End of Presentation