

# SYNTAX

Sudeshna Sarkar

14 AUG 2019

# Syntax

- Constituency
- Ordering
- Grammatical relations and dependency
  - Heads, agreement, grammatical function
- Key formalisms
  - Context-free grammars
  - Dependency grammars
- Resources
  - Treebanks

# Constituency

- Basic idea: groups of words act as a single unit
- Constituents form coherent classes that behave similarly
  - With respect to their internal structure: e.g., at the core of a noun phrase is a noun
  - With respect to other constituents: e.g., noun phrases generally occur before verbs

# Constituency: Example

- Noun phrases in English...

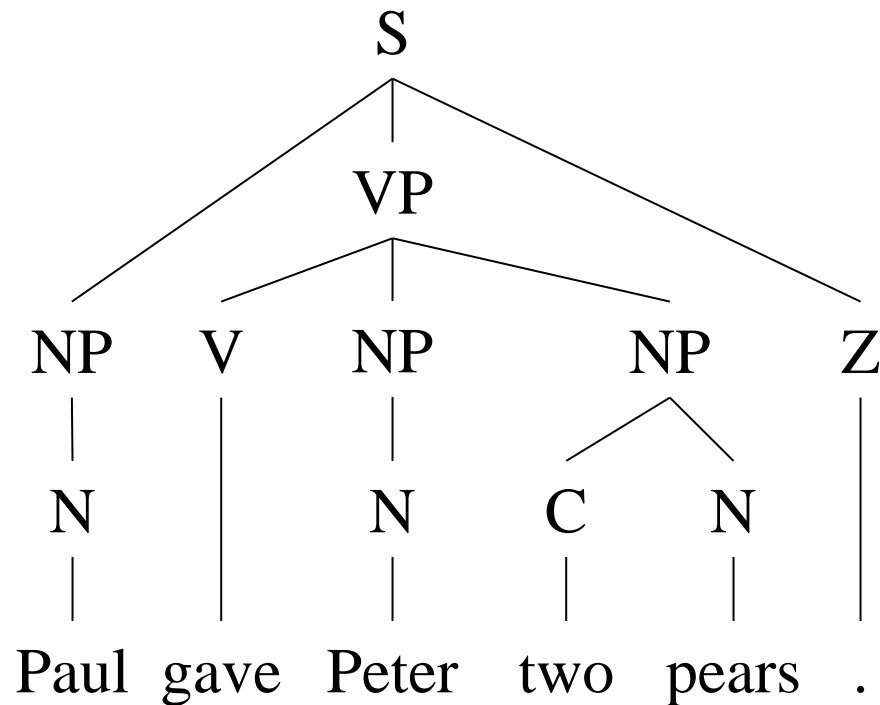
Harry the Horse  
the Broadway coppers  
they

a high-class spot such as Mindy's  
the reason he comes into the Hot Box  
three parties from Brooklyn

- They can all precede verbs
- They can all be preposed/postposed

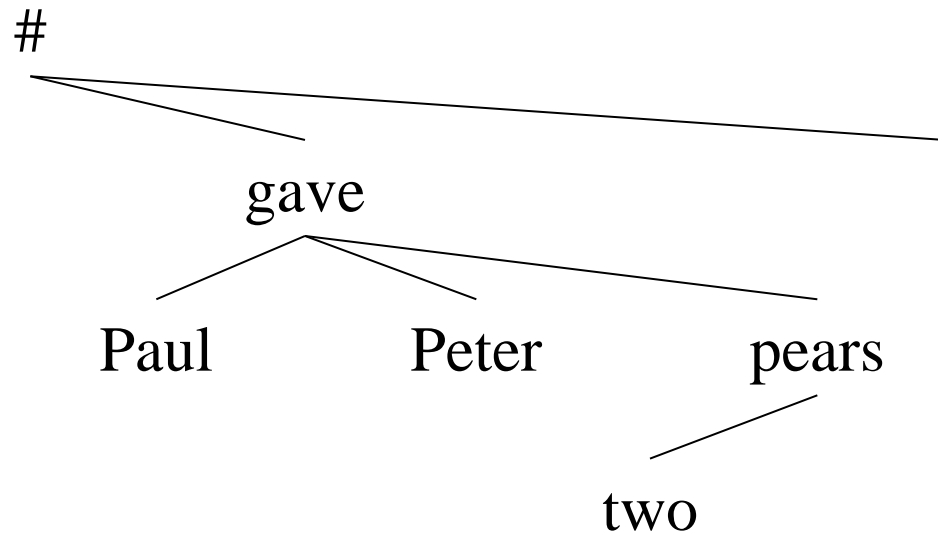
# Example of Constituent Tree

((Paul (gave Peter (two pears))) .)



# Example of Dependency Tree

[#,0] ([gave,2] ([Paul,1], [Peter,3], [pears,5] ([two,4])), [.,6])



# Words and Phrases

- Word (token): smallest unit of the syntactic layer
  - grammatical (function) words
  - lexical (content) words
- Phrase
  - Sequence of immediate constituents (words or phrases).
- Phrase types by their main word—**head**
  - Noun phrase: *the new book of my grandpa*
  - Adjectival phrase: *brand new*
  - Adverbial phrase: *very well*
  - Prepositional phrase: *in the classroom*
  - Verb phrase: *to catch a ball*

# Noun Phrase

- A noun or a (substantive) pronoun is the head.
  - water
  - *the book*
  - *new ideas*
  - *two millions of inhabitants*
  - *one small village*
  - *the greatest price movement in one year since the World War II*
  - *operating system that, regardless of all efforts by our admin, crashes just too often*
  - he
  - whoever



# Evidence of Constituency

1. They can all appear in similar syntactic environments
  - NP before a verb
2. Preposed or Postposed constructions
  - The prepositional phrase can be placed in a number of different locations in the sentence
  - But the individual words in the phrase cannot.

# Adjective Phrase

- An adjective or a determiner (attributive pronoun) is the head.
- Simple ADJPs are very frequent, complex ones are rare.
  - *old*
  - *very old*
  - *really very old*
  - *five times older than the oldest elephant in our ZOO*
  - *sure that he will arrive first*

# Adverbial Phrases

- An adverb is the head.
  - quickly
  - *much* more
  - how
  - louder *than you can imagine*
  - yesterday

# Prepositional (Postpositional) Phrase

- The preposition serves as head (because it determines the case of the rest of the phrase).
- Often have a function similar to adverbial phrases or noun phrases (object of a verb).
  - *in the city center*
  - *in God*
  - *around five o'clock*
  - *to a better future*
  - *up to a situation where neither of them could back out*
  - *with respect to his nonage*

# Clause and Sentence

- Group of words with 1 predicate, e.g.:
  - *John loves Mary.*
  - *...that you are right.*
  - simple sentence or **part of** compound sentence
- Sentence
  - simple sentence or compound sentence
  - consists of one or more clauses
  - e.g. *John loves Mary.* or *“I realized that you were right.”*

# Clause and Sentence

- Main clause
  - Independent of other clauses in the sentence
- Nested clause, relative clause
  - Depends on another clause, carries out a function in that clause (as a dependent phrase)
  - This is the man [that] I saw

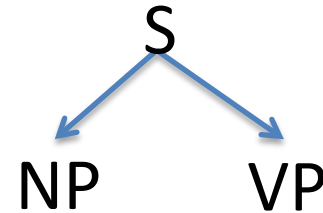
## Sentence

- Consists of one or more main clauses.
- If there are more than one main clause then they are usually coordinated.

# Formal Grammars of English

# Context-free grammars (CFGs)

- Consist of
  - Rules
  - Terminals
  - Non-terminals
  - Start Symbol
- Specifies a set of tree structures that capture constituency and ordering in language



$N$  a set of **non-terminal symbols** (or variables)

$\Sigma$  a set of **terminal symbols** (disjoint from  $N$ )

$R$  a set of **rules** or productions, each of the form  $A \rightarrow \beta$ ,  
where  $A$  is a non-terminal,

$\beta$  is a string of symbols from the infinite set of strings  $(\Sigma \cup N)^*$

$S$  a **designated start symbol** and a member of  $N$

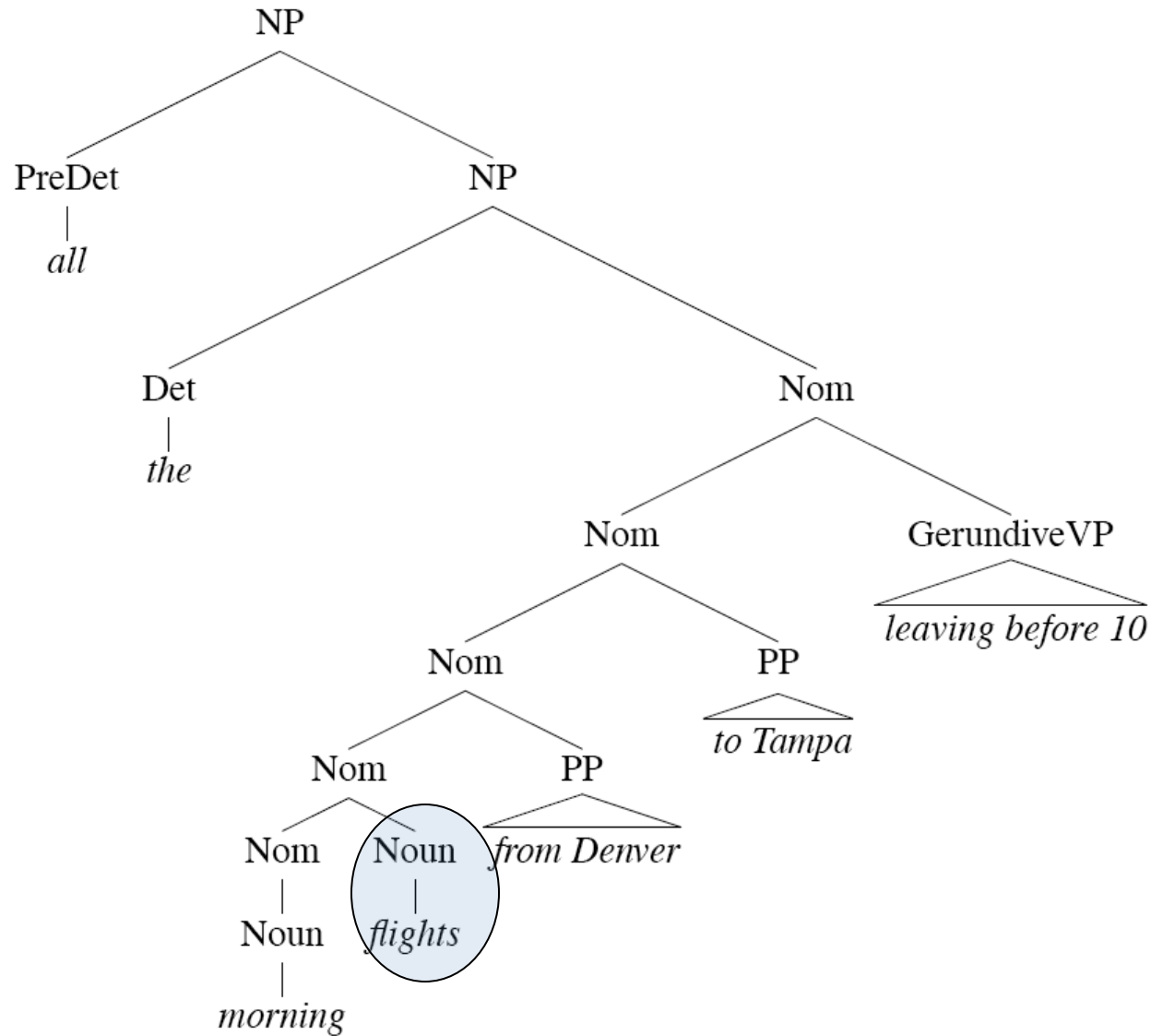


# Productions of CFG

- A CFG can be thought of in two ways:
  - a device for generating sentences  
(Derivation)
  - a device for assigning a structure to a given sentence.
- Some rules for noun phrases:

$$NP \rightarrow Det\ Nominal$$
$$NP \rightarrow ProperNoun$$
$$Nominal \rightarrow Noun \mid Nominal\ Noun$$

# Noun Phrases



# Nominals

- Contain the head and any pre- and post- modifiers of the head.
  - Pre-
    - Quantifiers, cardinals, ordinals...
      - *Three* cars
    - Adjectives
      - *large* cars

# Postmodifiers

- Three kinds
  - Prepositional phrases
    - *From Seattle*
  - Non-finite clauses
    - *Arriving before noon*
  - Relative clauses
    - *That serve breakfast*
- Same general (recursive) rules to handle these
  - *Nominal → Nominal PP*
  - *Nominal → Nominal GerundVP*
  - *Nominal → Nominal RelClause*

# Verb Phrases

- English *VPs* consist of a verb (the head) along with 0 or more *following* constituents which we'll call *arguments*.

$VP \rightarrow Verb$  disappear

$VP \rightarrow Verb NP$  prefer a morning flight

$VP \rightarrow Verb NP PP$  leave Boston in the morning

$VP \rightarrow Verb PP$  leaving on Thursday

# Subcategorization

- Even though there are many valid VP rules in English, not all verbs are allowed to participate in all those VP rules.
- We can *subcategorize* the verbs in a language according to the sets of VP rules that they participate in.
- This is just an elaboration on the traditional notion of transitive/intransitive.
- Modern grammars have many such classes

# Subcategorization

- Sneeze: John sneezed
- Find: Please find [a flight to NY]<sub>NP</sub>
- Give: Give [me]<sub>NP</sub>[a cheaper fare]<sub>NP</sub>
- Help: Can you help [me]<sub>NP</sub>[with a flight]<sub>PP</sub>
- Prefer: I prefer [to leave earlier]<sub>TO-VP</sub>
- Told: I was told [United has a flight]<sub>S</sub>
- ...

# Generative Grammar

- The use of formal languages to model Generative natural languages is called ***generative grammar*** since the language is defined by the set of possible sentences “generated” by the grammar.
- You can view these rules as either analysis or synthesis engines
  - Generate strings in the language
  - Reject strings not in the language
  - Assign structures (trees) to strings in the language



# L0 Grammar

Grammar Rules	Examples
$S \rightarrow NP VP$	I + want a morning flight
$NP \rightarrow$ <ul style="list-style-type: none"><li><math>Pronoun</math></li><li><math>Proper-Noun</math></li><li><math>Det Nominal</math></li></ul>	I Los Angeles a + flight
$Nominal \rightarrow$ <ul style="list-style-type: none"><li><math>Nominal Noun</math></li><li><math>Noun</math></li></ul>	morning + flight flights
$VP \rightarrow$ <ul style="list-style-type: none"><li><math>Verb</math></li><li><math>Verb NP</math></li><li><math>Verb NP PP</math></li><li><math>Verb PP</math></li></ul>	do want + a flight leave + Boston + in the morning leaving + on Thursday
$PP \rightarrow Preposition NP$	from + Los Angeles

# Sentence Types

- Declaratives: *A plane left.*

$S \rightarrow NP VP$

- Imperatives: *Leave!*

$S \rightarrow VP$

- Yes-No Questions: *Did the plane leave?*

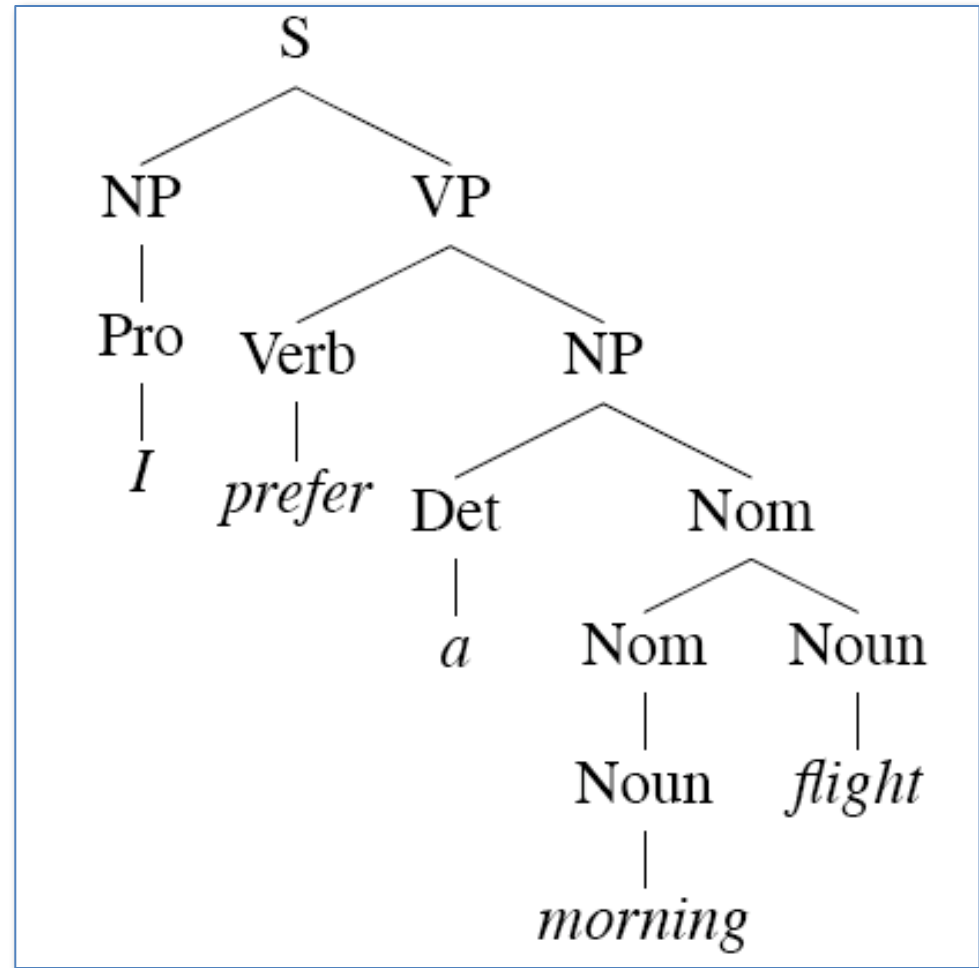
$S \rightarrow Aux NP VP$

- WH Questions: *When did the plane leave?*

$S \rightarrow WH-NP Aux NP VP$

# Derivations

- A *derivation* is a sequence of rules applied to a string that *accounts* for that string
  - Covers all the elements in the string
  - Covers only the elements in the string



# Parsing

- Parsing is the process of taking a string and a grammar and returning parse tree(s) for that string