

# Syntax

## LING 200: Introduction to the Study of Language

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# Outline

- 1 Constituency
  - Defining constituents
  - Organizing constituents
  - Constituency tests
- 2 Building trees
- 3 Modification and Ambiguity
  - Modification matters
  - Structural ambiguity
  - Anatomy of a tree
  - Constituency and ambiguity

Slides credit: Jessica Coon, Rebecca Starr

# Reminder

## Morphological tests for word class membership

- Affixes only attach to certain word classes.
- For example, any word that can take a past tense suffix -ed is a verb:
  - walked, studied, laughed, ...
- But: if a word cannot take -ed, that doesn't mean it's not a verb.
  - ate (\*eated), went (\*goed)

## Reminder

### Syntactic tests for word class membership

- We can also construct **syntactic frames** that only certain word classes can fit in:
  - (1)
    - a. Kai walked yesterday.
    - b. Kai ran yesterday.
    - c. Kai sauntered yesterday.
  - (2)
    - a. \* Kai cats yesterday.
    - b. \* Kai purple yesterday.
    - c. \* Kai under yesterday.
- As with morphological tests, we can claim that all words which fill this slot are verbs, but failing this test doesn't mean a word is not a verb.

# Syntax

## Sentence structure

- What does the internal structure of a sentence look like?
  - What are the units that make up a sentence?

## Are sentences composed of words?

- Well, yes, sentences do contain sequences of words.
- Does that mean that syntax is really just the study of word order?

# Syntax

Is sentence structure just about word order?

(3) Francesco ate apples.

- Who did the eating?
- What was eaten?

# Syntax

## Is sentence structure just about word order?

(3) Francesco (N) ate (V) apples (N).

- Given a sentence like this, it is tempting to say that we can best analyze sentences as a string of words.
- The words that are adjacent to each other have a close relationship in terms of their syntactic function.

# Syntax

Is sentence structure just about word order?

(4) The little girl I met yesterday ate an apple.

- Who did the eating in this sentence?



# Syntax

## Is sentence structure just about word order?

(4) The little **girl** I met yesterday **ate** an apple.

- The girl ate the apple.
- But “girl” is so far away from “ate”!
- How do we know that “I” am not the one who ate the apple? “I” is closer to “ate.”

# Syntax

## Is sentence structure just about word order?

(4) [The little girl I met yesterday] ate an apple.

- We have an intuition that there is a chunk of words that group together, like this.
- This chunk is not a sentence or a word, but it seems to be an important unit that we use in order to understand the meaning of this sentence.

# Syntax

## Is sentence structure just about word order?

- Let's look at two more examples:
  - (5) a. The phone that I bought at **the mall** **is** broken.
  - b. **The mall** **is** across the street.
- Is the relationship between “the mall” and “is” the same in (a) and (b)?
- No. Even though “the mall” is next to “is” in (a), the subject of “is” is the phone, not the mall.
  - The mall is not broken!
- If we analyze these sentences as sequences of words, we cannot account for this difference between (a) and (b).

# Syntax

Is sentence structure just about word order?

- (5) a. [The phone that I bought at the mall] is broken.  
b. [The mall] is across the street.
- Again, we have an intuition that there are chunks of words within this sentence.
    - In (a) the subject is “the phone that I bought at the mall”
    - In (b) the subject is “the mall”

# Syntax

## Is sentence structure just about word order?

- Let's look more closely at this chunk in (a):

(6) [The phone that I bought at the mall]

- Within this unit, we can identify smaller units that intuitively seem to go together. And then even smaller units nested within those units:
  - I bought at the mall
  - at the mall
  - the mall

# Syntax

## Conclusion: sentence structure is not just about word order

- We cannot account for how we parse sentences only using the unit of the word.
- As we have just seen, we can identify additional units between the level of the word and the sentence.
  - Moreover, these units are nested inside of each other hierarchically.

## Words are organized into hierarchical units

- Using constituency tests, we find that sentences have patterns like this:

(7) The baby threw steamed broccoli on the floor.

- ➔ Constituents are always *nested*



- We don't find anything like this:

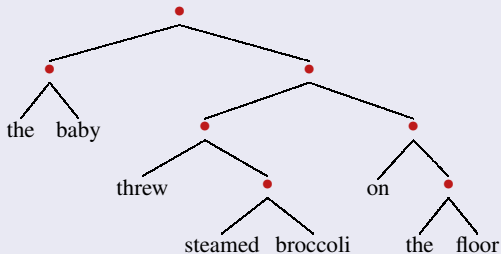
(8) \* Word 1 Word 2 Word 3

## Representing constituents using trees

(9) The baby threw steamed broccoli on the floor.

- We can represent this using trees:

(10)



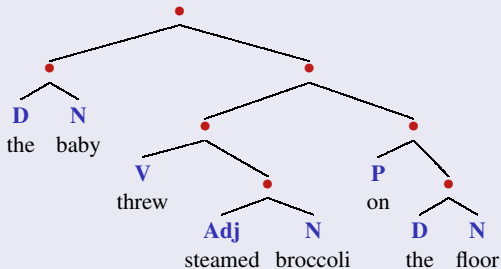
➡ Every **node** (= •) on the tree represents a constituent



## Representing constituents using trees

- Now we can use our part of speech labels:

(11)



➡ What about the nodes?

## Labeling nodes

### Remember our distribution tests?

- (12) a. Kai [<sub>V</sub> ran] yesterday.  
b. Kai [ threw steamed broccoli ] yesterday.  
c. Kai [ threw steamed broccoli on the floor ] yesterday.

➡ The string *threw steamed broccoli* acts like a verb = **Verb Phrase (VP)**.

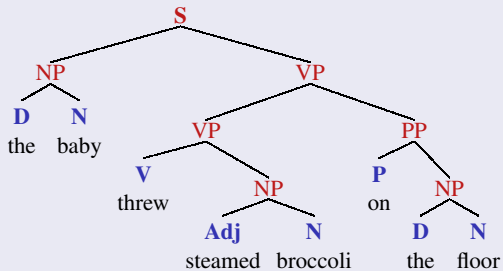
➡ ... so does *threw steamed broccoli on the floor*.

- (13) a. Sophie saw [<sub>N</sub> cows].  
b. Sophie saw [ the baby ].  
c. Sophie saw [ steamed broccoli ].

➡ The constituents *the baby* and *steamed broccoli* act like nouns  
= **Noun Phrase (NP)**.

## Representing constituents using trees

(14)



## Replacement / Substitution

- We can provide empirical evidence for the intuitions we have that some words in a sentence “go together” more than others do.

### Replacement

- Some constituents can be replaced by other words without radically changing the meaning:
  - (15) a. Sophie threw her steamed broccoli on the floor.
  - b. Sophie threw it on the floor.
- Non-constituents cannot
  - (16) a. Sophie threw her steamed broccoli on the floor.
  - b. \* Sophie threw her steamed it floor.

## Fragment / Stand-Alone

### Fragment

- If words can stand alone in response to a question, they are probably a constituent.
  - (17) a. What did Sophie throw on the floor?  
b. Her steamed broccoli.
  - (18) a. Where did Sophie throw her broccoli?  
b. On the floor.
- Non-constituents cannot
  - (19) a. ... ???  
b. Broccoli on the.  
c. Sophie throw on.

# Movement

## Movement

- Some constituents can move as units

- (20) a. Sophie threw her steamed broccoli on the floor.  
b. Her steamed broccoli *is what* Sophie threw \_\_\_ on the floor.

- Non-constituents cannot

- (21) a. Sophie threw her steamed broccoli on the floor.  
b. Broccoli on the *is what* Sophie threw her steamed \_\_\_ floor.

## Two kinds of movement

### Clefting — *It was... that*

- (22) Sophie threw her steamed broccoli on the floor.
- It was her steamed broccoli that* Sophie threw \_\_\_ on the floor.
  - It was on the floor that* Sophie threw her steamed broccoli \_\_\_.
  - \* *It was her steamed that* Sophie threw \_\_\_ broccoli on the floor.

### Preposing / pseudo-clefting — *... is/are what/where/who*

- (23) Sophie threw her steamed broccoli on the floor.
- Her steamed broccoli is what* Sophie threw \_\_\_ on the floor.
  - On the floor is where* Sophie threw her steamed broccoli \_\_\_.
  - \* *Her steamed is what* Sophie threw \_\_\_ broccoli on the floor.

# Coordination

## Coordination

- Some constituents can be coordinated with like constituents

- (24)
- a. Sophie threw [ her steamed broccoli and the water ] on the floor.
  - b. Sophie threw her steamed broccoli [ on the floor and in the garbage ].
  - c. Sophie [ threw her steamed broccoli on the floor and screamed ].

▶▶ Be careful! Not all constituents will pass all of these tests, and not all *non*-constituents will fail them!



# Practice

- (25) Allison ate dinner with the student from Calgary at a really fancy restaurant.

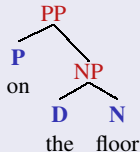
# How do we build trees?



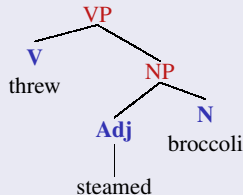
# Rules

- Now we are in a position to begin creating rules that form grammatical sentences ( $\rightarrow$  *generative grammar*)

(26)



(27)



- (28)
- $PP \rightarrow P NP$
  - $VP \rightarrow V NP$
  - $NP \rightarrow Adj N$
  - $NP \rightarrow D N$

“A PP consists of a P and an NP”

“A VP consists of a V and an NP”

“An NP consists of an Adj and an N”

“An NP consists of a D and an N”

# Rules

## Condensing our rules

- (29)
- a. [<sub>NP</sub> The student ] loves syntax.
  - b. [<sub>NP</sub> Tall students ] love syntax.
  - c. [<sub>NP</sub> Ian ] loves syntax.
  - d. [<sub>NP</sub> Students ] love syntax.
  - e. [<sub>NP</sub> The blonde student ] loves syntax.
  - f. [<sub>NP</sub> The blonde student [<sub>PP</sub> from Halifax ] ] loves syntax.

(30) NP → (D) (AdjP) N (PP)

► All NPs must contain a **noun**; we call the noun the *head* of the NP

# Rules

We can do the same thing for verbs...

- (31) a. The student [<sub>VP</sub> **walked** ].  
b. The student [<sub>VP</sub> **walked** [<sub>PP</sub> towards the mountain ] ].  
c. The student [<sub>VP</sub> quickly **ate** [<sub>NP</sub> the pizza ] ].  
d. The student [<sub>VP</sub> **put** [<sub>NP</sub> the book ] [<sub>PP</sub> on the table ] ].  
e. The student [<sub>VP</sub> **put** [<sub>NP</sub> the book ] [<sub>PP</sub> on the table ] yesterday ].

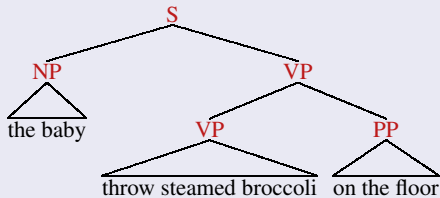
(32)  $VP \rightarrow (Adv) \mathbf{V} (NP) (PP)$

► All VPs must contain a **verb**

# Clauses

Now we need rules to build a sentence

(33)



(34)  $S \rightarrow NP VP$

# Summary

## Hierarchy and constituents

- Sentences contain hierarchical structure.
- Words form constituents, which are combined to build larger constituents.
- Constituency tests:
  - Replacement / Substitution
  - Fragment
  - Movement
  - Coordination

## Rules

- The content of constituents can be described using Phrase Structure Rules (*aka* “rewrite rules”).
- Phrases have *heads*; heads give categories to their phrases. V is the head of VP, N is the head of NP...

# Modification

## Two NPs:

- (35) a. the **tall green** dinosaur  
b. the very **green** dinosaur

- In (35a), both *tall* and *green* modify *dinosaur*—they both describe properties of the dinosaur
- In (35b), *green* modifies *dinosaur*—but *very* does not

(36) \* very dinosaur

➡ Our theory of syntax needs to represent this. . .



## Modification matters!



# Modification matters!

## Ambiguities

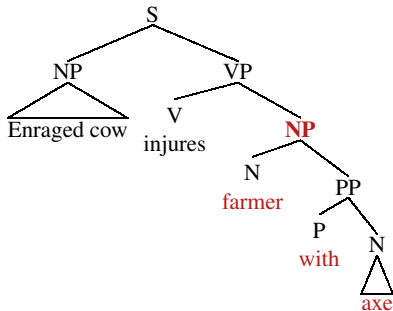
- (37) Enraged cow injures farmer with axe.
- (38) The students discussed sex with Oprah.
- (39) “I shot an elephant in my pajamas. . .  
how he got in there, I’ll never know.” — Groucho Marx

- **Testable hypothesis:** sentences with *structural ambiguities* have different structures
- Each meaning corresponds to a different structure

## Structural ambiguity

(40) Enraged cow injures [farmer with axe]<sub>NP</sub>.

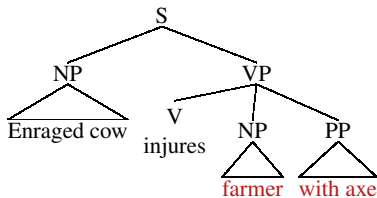
(41)



## Structural ambiguity

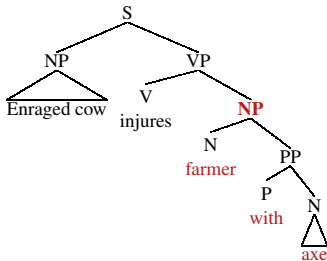
(42) Enraged cow injures [farmer]<sub>NP</sub> [with axe]<sub>PP</sub>.

(43)

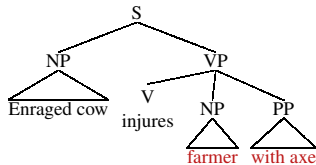


## Structural ambiguity

(44)



(45)



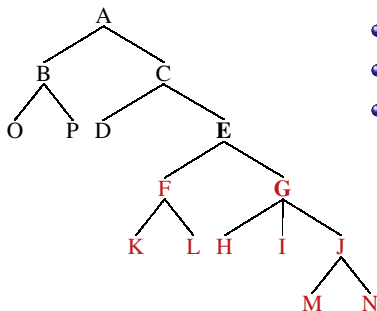
- The string *farmer with axe* is a constituent in (44)
- But not in (45)
- ➡ A constituent is a node and *everything* it dominates

# Anatomy of a tree



## Anatomy of a tree

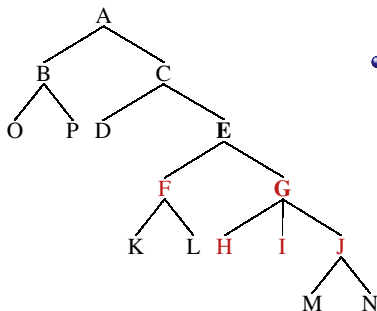
(46)



- **E** dominates...
- **G** dominates...
- **G** *immediately* dominates...
- **E** *immediately* dominates...

## Anatomy of a tree

(47)

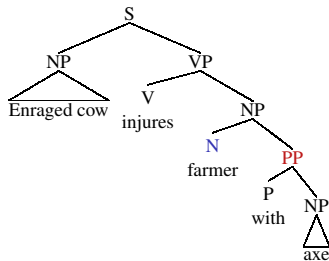


- F and G are *sisters*;  
E is the *mother* of F and G
- H, I, and J are *sisters*;  
G is the *mother* of H, I, and J

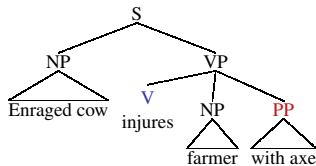


## Back to our trees...

(48)



(49)

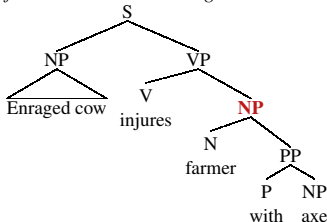


Principle of modification:

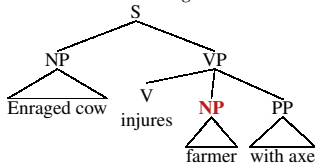
If an **XP** (a phrase) modifies some head **Y**, then **XP** must be a sister to **Y**.

## Back to our trees...

(50) *farmer-with-axe-reading*



(51) *cow-with-axe-reading*



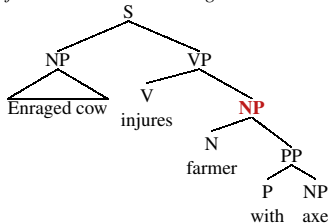
### Constituency tests: replacement

- The different structures in (53) and (54) should behave differently with respect to *constituency tests*.

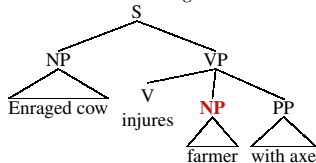
- (52) a. An enraged cow injured **him**.  
b. An enraged cow injured **him** with an axe.

## Constituency tests

(53) *farmer-with-axe-reading*



(54) *cow-with-axe-reading*

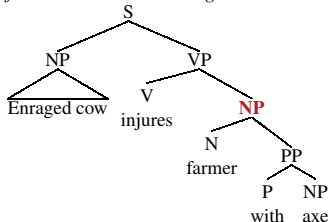


### Constituency tests: Movement

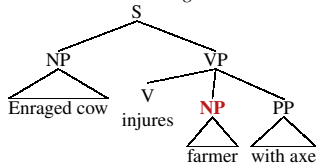
- (55) a. [A farmer with an axe]<sub>NP</sub> is who the enraged cow injured.  
 b. [A farmer]<sub>NP</sub> is who the enraged cow injured with an axe.

## Constituency tests

(56) *farmer-with-axe-reading*



(57) *cow-with-axe-reading*



### Constituency tests: Coordination

- (58) a. Enraged cow injures [farmer with axe]<sub>NP</sub> and [two dogs]<sub>NP</sub>.  
 b. Enraged cow injures [farmer]<sub>NP</sub> and [two dogs]<sub>NP</sub> with axe.

## Practice

- (59) The young men and women built the house.
- [ The young [ men and women ] ] built the house.
  - [ [ The young men ] and [ women ] ] built the house.
- (60) Sophie put the box on the table in the kitchen.
- Sophie [ put [ the box on the table] [ in the kitchen ] ]
  - Sophie [ put [ the box ] [ on the table in the kitchen ] ]
- (61) Morgan ordered popcorn for the student at the bar.
- Morgan [ ordered [ popcorn for [ the student at the bar ] ]
  - Morgan [ ordered [ popcorn for [ the student ] ] [ at the bar ] ]

## Fun with garden paths. . .

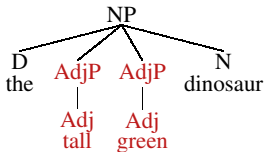


- (62) The horse raced past the barn fell.
- (63) I convinced her children are noisy.
- (64) The dog that I had really loved bones.
- (65) Mary gave the child the dog bit a bandaid.
- (66) The man who hunts ducks out on weekends.

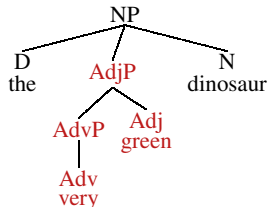
## Back to our trees...

- (67) a. the tall green dinosaur  
b. the very green dinosaur

(68)



(69)

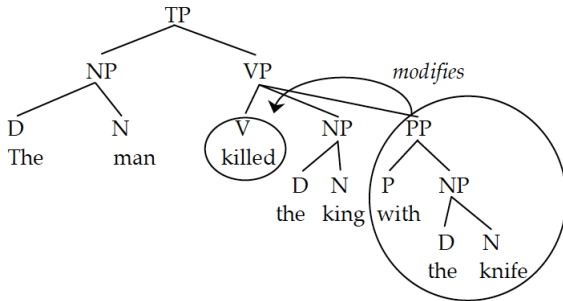


- In (68), *tall* and *green* both modify (are sisters to) *dinosaur*
- In (69), *very* modifies *green*...
- and *very green* modifies *dinosaur*

## One more example

(70) The man killed the king with a knife.

(71)

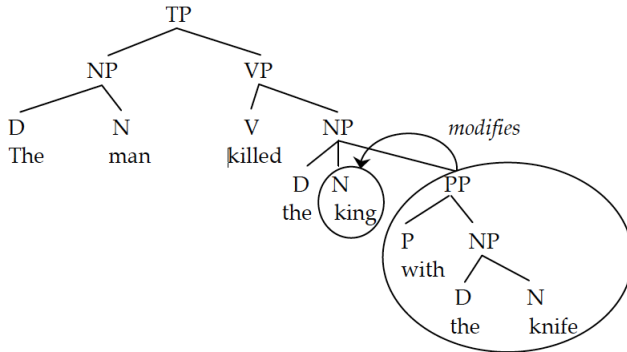




## One more example

(72) The man killed the king with a knife.

(73)



# Summary

## Modification

- Different structure = different meaning: we can represent syntactic ambiguities with trees
- **Principle of modification:** If an XP (a phrase) modifies some head Y, then XP must be a sister to Y.
- Different structures make different predictions about *constituency*: constituency tests can be used to test the structures we propose

## Tree relations:

- Mother, daughter, sister
- Dominate, immediately dominate

## For next time...

- ▶ **Read:** Mihalicek & Wilson “Language Files”, chapter 5.5 (pages 222-9), in course pack.