Today

- Phrase structure rules, trees
- Constituents
- Recursion
- Conjunction

Readings: 6.4 – 6.5
Phrase structure (review)

1) Every word belongs to a *lexical category*
2) Lexical categories form heads of *phrases*
3) How phrases are formed is governed by rules (= ‘*phrase structure rules*’)

Phrase structure rules

- Rules that determine…
  - …what goes into a phrase (‘constituents’)
  - …how the constituents are ordered

- **Constituent**: a word or group of words that function as a unit and can make up larger grammatical units
Phrase structure rules

- General schema:
  \[ X \rightarrow Y \quad Z \]
  “X consists of Y followed by Z”
Phrase structure rules

Noun phrase (NP)
- John
- the boy
- a little boy
- a boy in a bubble

Phrase structure rule for NPs:
\[ NP \rightarrow (\text{Det}) \ (\text{Adj}) \ \text{N} \ (\text{PP}) \]

(where ‘( )’ indicates optionality)
Phrase structure trees

NP
  N
    John

NP
  Det
    the
  N
    boy

NP
  Det
    a
  Adj
    little
  N
    boy

NP
  Det
    a
  N
    boy
  PP
    P
      in
    Det
      a
    N
      bubble
Prepositional phrase (PP)

- in  P
- from a boy in a bubble  P NP

Phrase structure rule for PPs:

$$ PP \rightarrow P \ (NP) $$
Phrase structure trees

PP
  ↓
  P
  ↓
in

PP
  ↓
P
  ↓
from

NP
  ↓
  Det
  ↓
  N
  ↓
  a
  ↓
boy

PP
  ↓
P
  ↓
in

NP
  ↓
  Det
  ↓
  N
  ↓
a
  ↓ bubble
Recursion

- Some phrasal categories may appear to the left or right of the arrow
  - NP $\rightarrow$ (Det) N (PP)
  - PP $\rightarrow$ P (NP)

- **Recursion**: the property of language that allows for the embedding of categories (which can yield infinitely long phrases)
the cat on the mat in the house on the street
Verb phrase (VP)

- sang  \( V \)
- ate the cake  \( V \ NP \)
- ate the cake hungrily  \( V \ NP \ Adv \)
- sang a song in the shower  \( V \ NP \ PP \)
- fell into the pond slowly  \( V \ PP \ Adv \)

Phrase structure rule for VPs:

\[ VP \rightarrow V \ (NP) \ (PP) \ (Adv) \]
sang  
\textit{ate}  
the  
cake

sang  
\textit{a song}  
in  
the  
shower

sang  
\textit{the cake}  
in  
the  
shower
Structural ambiguity

discuss [sex with Dr. Ruth]  [discuss sex] with Dr. Ruth
Structural ambiguity

- discuss [sex with Dr. Ruth]
- [discuss sex] with Dr. Ruth
Sentences

- Must contain an NP and a VP
  - The dog barked.
  - *The dog.
  - *Barked.

- May contain an auxiliary verb
  - The dog will bark.

S → NP (Aux) VP
The dog ate the bone.
The dog will eat the bone.
Conjunction

Words and phrases of the same category can be combined using conjunctions (*and*, *but*, *or*)

- Cats **and** dogs make good pets.
- Eat, drink, **or** be merry.
- You can lead a horse to water **but** you can’t make him drink.

NP → NP conj NP
VP → VP conj VP → X → X conj X
S → S conj S
Conjoined phrases

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NP  NP  Conj  NP
   NP  ConjugateNP
      Det  N  NP  Det  N
the  cat  and  the  dog
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NP → NP Conj NP
NP → Det N
Conjoined sentences

I bought a book, but I returned it.

S → S conj S

NP VP but NP VP

I V NP I V NP

bought a book returned it