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 forms 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:
  \[ X \rightarrow Y \ Z \]
  “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:

\[ NP \to (\text{Det}) \ (\text{Adj}) \ N \ (\text{PP}) \]

(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
  - NP
    - bubble
Prepositional phrase (PP)

- in
- from a boy in a bubble

Phrase structure rule for PPs:

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

```
PP
  P
  in

PP
  P
  from
  Det
  N
  boy

PP
  P
  in
  Det
  N
  a
  bubble
```
Recursion

- Some phrasal categories may appear to the left or right of the arrow
  
  NP → (Det) N (PP)
  PP → 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
 ate
  Det
   N
    the
     cake

sang
 Det
  N
   a song
    in
     Det
      N
        the
         shower

badly
Structural ambiguity

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

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

VP

V  NP

discuss  sex  PP

NP

sex  P  NP

V

discuss  sex  NP

PP

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 $\rightarrow$ NP (Aux) VP
The dog ate the bone

S → NP VP
The dog will eat the bone.

S → NP Aux VP
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 \(\rightarrow\) NP conj NP

VP \(\rightarrow\) VP conj VP \(\rightarrow\) X \(\rightarrow\) X conj X

S \(\rightarrow\) S conj S
Conjoined phrases

NP → NP Conj NP

NP
  └── Conj
    └── NP
      └── Det N
        └── the cat

NP
  └── Det N
    └── the dog

NP
  └── Det N
    └── the dog

NP
  └── Conj
    └── NP
      └── Det N
        └── the dog
Conjoined sentences

I bought a book, but I returned it.

S → S conj S

NP VP
I V NP
bought a book

S
conj
but

S
NP VP
I V NP
returned it