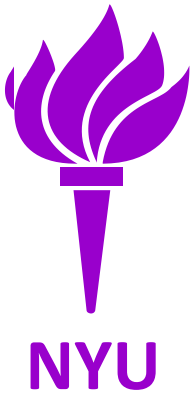


Syntactic Ambiguity

CSCI-GA.2590 – Lecture 3B

Ralph Grishman

Part-of-speech Ambiguity

- Many English words have 2 (or more) parts of speech
    - the last fast train speeds up station schedules
- produces lots of structures during parsing

Attachment Ambiguity

- PPs [prepositional phrases] can modify any of several prior constituents:

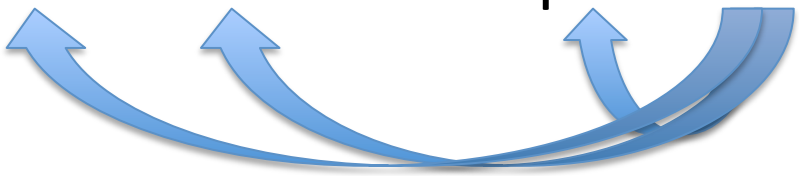
I saw the man in the park

?

Grows rapidly

- Ambiguity grows rapidly with size of sentence

I saw the man in the park with a telescope



I saw the man on a hill in the park with a telescope

Grows rapidly

- Number of parses (and time) grows as n!

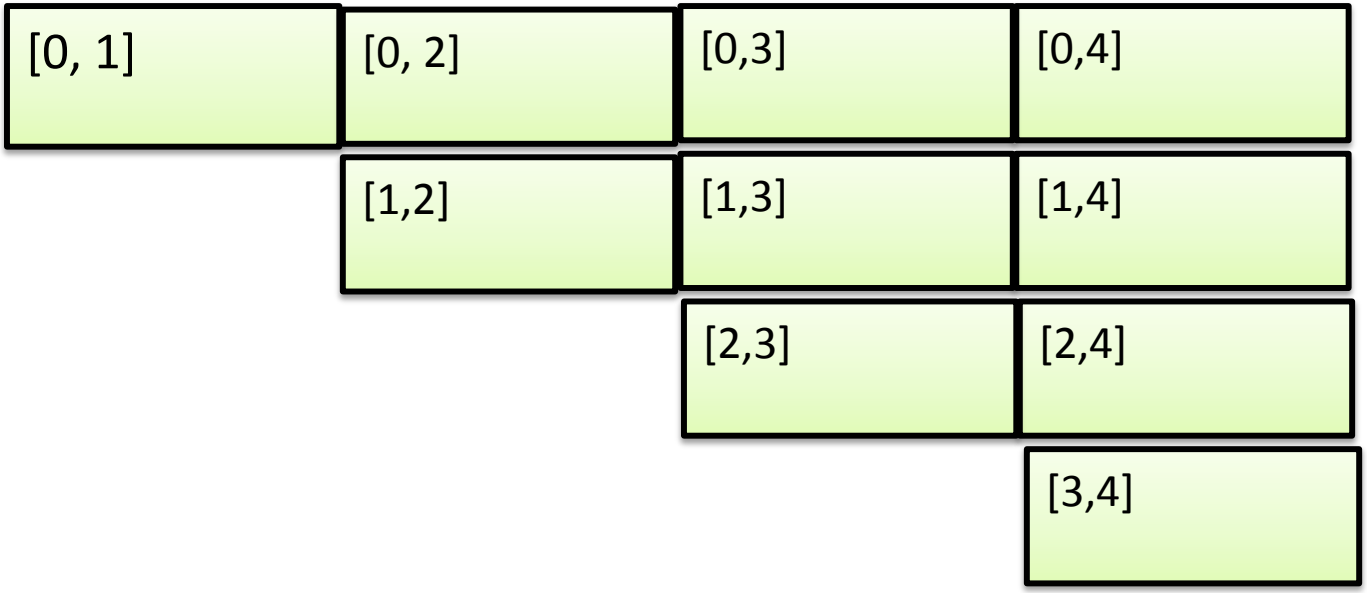
(n factorial … faster than exponential)

Dynamic programming

- Group together all analyses of span<i, j> as grammar symbol X
  - factored representation of parse trees
- $n^2/2$ spans for an n-word sentence
- with binarized form of grammar, can parse in polynomial time ($O(n^3)$)

CKY parse table

- one cell for each possible span
  - combine different derivations of same symbol with same span



Doesn't solve the problem

- Dynamical programming allows us to generate multiple parses much faster, but doesn't really solve the problem:
  - what do we do with all these parses?
  - how do we select the likely interpretation of the sentence?

Adding constraints

- our simple grammar generates lots of non-sentences (*Cat sleep.)
- can we reduce the number of parses by incorporating some constraints, such as:
  - number agreement
  - subcategorization
  - selection

Number Agreement

sentence	→ np-sing vp-sing | np-plur vp-plur
np-sing	→ ngroup-sing | ngroup-sing pp
ngroup-sing	→ n-sing | art-sing n-sing | art-sing adj n-sing
vp-sing	→ v-sing | v-sing np | v-sing vp | v-sing np pp
np-plur	→ ngroup-plur | ngroup-plur pp
ngroup-plur	→ n-plur | art-plur n-plur | art-plur adj n-plur
vp-plur	→ v-plur | v-plur np | v-plur vp | v-plur np pp
pp	→ p np

Cats sleep. *Cats sleep.

Subcategorization

sentence → np vp

np → ngroup | ngroup pp

ngroup → n | art n | art adj n

vp → v-intrans | v-trans np | v-xcomp vp |
v-ppcomp np pp

pp → p np

He sleeps. *He sleeps dreams.

Little gain

- Each constraint enlarges grammar substantially
- Effect of multiple constraints is multiplicative
- Except for subcategorization, benefit is small
  - few bad parses are eliminated

What's left?

How do we *really* cope with ambiguity?

- Probabilistic grammar
  - to discuss in detail in a few weeks
- Partial parsing
  - to discuss next
  - only parse as much as we need
  - will need to resolve part-of-speech ambiguities first0