538 Presentations

• So far I've received responses from the following people:

<table>
<thead>
<tr>
<th>Name</th>
<th>Column1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last</td>
<td>First</td>
</tr>
<tr>
<td>Romero Diaz</td>
<td>Damian</td>
</tr>
<tr>
<td>Muriel</td>
<td>Jorge</td>
</tr>
<tr>
<td>Pike</td>
<td>Ammon Johnson</td>
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<tr>
<td>Farahnak</td>
<td>Farideh</td>
</tr>
<tr>
<td>Lee</td>
<td>Puay Leng Patricia</td>
</tr>
<tr>
<td>Brown</td>
<td>Rachel</td>
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<tr>
<td>Sullivan</td>
<td>Trevor</td>
</tr>
<tr>
<td>Xu</td>
<td>Dongfang</td>
</tr>
</tbody>
</table>
Last Time

John kicked the ball
the men kicked the ball
a man kicked the ball

John kicked the ball
the men kicked the ball
a man kicked the ball

```
s(s(NP,VP)) --> np(NP), vp(VP).
np(np(NNP)) --> nnp(NNP).
np(np(DT,NN)) --> dt(DT,Number), nn(NN,Number).
nnp(nnp(X)) --> [X], {proper_noun(X)}.
nn(nn(X),sg) --> [X], {common_noun(X)}.
nn(nns(X),pl) --> [X], {common_noun_pl(X)}.
vp(vp(VBD,NP)) --> vbd(VBD), np(NP).
vbd(vbd(kicked)) --> [kicked].
dt(dt(the),_Number) --> [the].
dt(dt(a),sg) --> [a].

proper_noun(X) :- member(X,[john,mary,peter,bill,jill]).
common_noun_pl(X) :- member(X,[balls,buckets,men]).
common_noun(X) :- member(X,[ball,bucket,man]).
```
Phrase Structure Grammars

• Berkeley Parser: *John kicked the ball*

```
(ROOT
  (S
   (NP (NNP John))
   (VP (VBD kicked)
    (NP (DT the) (NN ball))))
)```

```
  ROOT
   |  S
   |   NP       NP
   |    |       |
   |    |       VP
   |    |       |
   |    |        NP
   |    |        |
   |    |        NN
   |    |        |
   |    |        the
   |    |        ball
```

*John kicked the ball*
Phrase Structure Grammars

• Berkeley Parser: *the men kicked the ball*

(\textsc{root}
 \hspace{1em} (\textsc{s}
 \hspace{1em} (\textsc{np} (\textsc{dt} the) (\textsc{nns} men))
 \hspace{1em} (\textsc{vp} (\textsc{vbd} kicked)
 \hspace{1em} (\textsc{np} (\textsc{dt} the) (\textsc{nn} ball))))

```plaintext
ROOT
 _
 S
 _
 NP      VP
 _
 DT  NNS  VBD  NP
 the  men  kicked  DT  NN
 the  ball
```
Phrase Structure Grammars

• Berkeley Parser: *a man kicked the ball*

```
(ROOT
 (S
  (NP (DT a) (NN man))
  (VP (VBD kicked)
   (NP (DT the) (NN ball))))))
```
?- s(Parse, [a, men, kicked, the, ball], []).  
   false.

?- s(Parse, [the, men, kicked, the, ball], []).  
   Parse = s(np(dt(the), nns(men)), vp(vbd(kicked), np(dt(the), nn(ball)))) ; 
   false.

?- s(Parse, [the, man, kicked, the, ball], []).  
   Parse = s(np(dt(the), nn(man)), vp(vbd(kicked), np(dt(the), nn(ball)))) ; 
   false.

?- s(Parse, [a, man, kicked, the, ball], []).  
   Parse = s(np(dt(a), nn(man)), vp(vbd(kicked), np(dt(the), nn(ball)))) ; 
   false.

?-
Phrase Structure Grammars

• Berkeley Parser: *a men kicked the ball*

(Root (S (NP (DT a) (NNP men)) (VP (VBD kicked) (NP (DT the) (NN ball))))))
Extra Arguments: Agreement

- English exhibits subject-verb agreement
- Examples:
  - John kicked the ball
  - The men kicked the ball
  - John kicks the balls
  - The men *kicks/kick the ball

Constraint:

1. -s form of the verb is compatible with 3rd person singular only for the subject NP
2. *uninflected* form is not compatible with 3rd person singular for the subject NP
Subject Verb Agreement

• We need feature percolation:

Subject and VP come together at this rule

Form | Ending | Comment
---|---|---
eat | uninflected | not 3rd person singular
eats | -s | 3rd person singular
ate | -ed | past
eaten | -en | past participle
eating | -ing | gerund

POS tags:
- VB - Verb, base form
- VBD - Verb, past tense
- VBG - Verb, gerund or present participle
- VBN - Verb, past participle
- VBP - Verb, non-3rd person singular present
- VBZ - Verb, 3rd person singular present
Subject Verb Agreement

• Implementation: using POS tags
  \[ v(vb(eat),vb) \rightarrow [eat]. \]
  \[ v(vbd(ate),vbd) \rightarrow [ate]. \]
  \[ v(vbg(eating),vbg) \rightarrow [eating]. \]
  \[ v(vbn(eaten),vbn) \rightarrow [eaten]. \]
  \[ v(vbp(eat),vbp) \rightarrow [eat]. \]
  \[ v(vbz(eats),vbz) \rightarrow [eats]. \]

• Constraint table:
  - % table of Person Number Tag possible combinations
    - table(3,plural,vb).
    - table(3,plural,vbd).
    - table(3,singular,vbz).
    - table(3,singular,vbd).
Topics

• Mechanisms:
  1. Extra argument for Prolog term representation of a parse
  2. Extra arguments for feature value agreement
  3. Dealing with left recursive rules: grammar transformation
Left recursion and Prolog

Left recursive grammars:
• we know from an earlier lecture that left recursive rules are a no-no given Prolog’s left-to-right depth-first computation rule...

• Example:
  1. \( s \rightarrow a, [!] \).
  2. \( a \rightarrow ba, [a] \).
  3. \( a \rightarrow a, [a] \).
  4. \( ba \rightarrow b, [a] \).
  5. \( b \rightarrow [b] \).

?- s([b,a,!?],[]).
ERROR: Out of local stack

...
Preposition Phrase (PP) Attachment

• The preferred syntactic analysis is a left recursive parse
• Examples:
  – *John saw the boy with a telescope*
  – (structural ambiguity: automatically handled by Prolog)
Preposition Phrase (PP) Attachment

- The preferred syntactic analysis is a left recursive parse.
  - Can “stack” PPs:
    - *John saw the boy with a limp with Mary with a telescope*
    - Ambiguity: $\text{with}_{\text{possessive}}$, $\text{with}_{\text{accompaniment}}$, $\text{with}_{\text{instrument}}$
Preposition Phrase Attachment

• Linguistically:
  – PP (recursively) adjoins to NP or VP
  – np(np(NP, PP)) --> np(NP), pp(PP).
  – vp(vp(VP, PP)) --> vp(VP), pp(PP).
• Left recursion gives Prolog problems
• Derivation (top-down, left-to-right):
  1. vp
  2. vp pp
  3. vp pp pp
  4. vp pp pp pp
  5. vp pp pp pp pp pp infinite loop...

other extra arguments not shown here ...
Transformation

- Apply the general transformation:
  - to NP and VP rules:
    1. $\text{np(np(DT,NN))} \rightarrow \text{dt(DT,Number), nn(NN,Number)}.$
    2. $\text{np(np(NP,PP))} \rightarrow \text{np(NP), pp(PP).}$
    3. $\text{vp(vp(VBD,NP))} \rightarrow \text{vbd(VBD), np(NP).}$
    4. $\text{vp(vp(VP,PP))} \rightarrow \text{vp(VP), pp(PP).}$

Note:
w is a fresh non-terminal that takes 2 arguments

$x(x(X,y)) \rightarrow x(X), [y].$
x(x(z)) \rightarrow [z].$

$w(W,X) \rightarrow [y], w(W,x(X,y)).$
w(x(X,y),X) \rightarrow [y].$