Features: Recap and Wrap-up

Scott Farrar
CLMA, University of Washington
farrar@u.washington.edu

February 8, 2010
Today’s lecture

1. Features: Recap
Advantages of using features in CFGs

An important motivation for feature structures is to capture fine-grained distinctions that would otherwise require a massive multiplication of atomic categories.

Example

- \( NP \rightarrow DT \ NN \)
  - ...the book
- \( NP \rightarrow DT \ NNS \)
  - ...the books
Advantages of using features in CFGs
An important motivation for feature structures is to capture fine-grained distinctions that would otherwise require a massive multiplication of atomic categories.

Example
- \( NP \rightarrow DT \ NN \)
  ...the book
- \( NP \rightarrow DT \ NNS \)
  ...the books

\( NP[ ] \rightarrow DT[num = ?n] \ Noun[num = ?n] \)
Advantages of using features in CFGs

An important motivation for feature structures is to capture fine-grained distinctions that would otherwise require a massive multiplication of atomic categories.

Example

- $NP \rightarrow DT \ NN$
  
  ...the book

- $NP \rightarrow DT \ NNS$
  
  ...the books

$NP[\ ] \rightarrow DT[num = ?n] \ Noun[num = ?n]$

$NP[num = ?n] \rightarrow DT[num = ?n] \ Noun[num = ?n]$

(for subj-verb agreement)
What makes a good feature?

One that accounts for a systematic grammatical distinction
One that fits within the overall grammatical system (doesn't contradict other distinctions)
One that is not too out-of-line with the feature systems in the known languages of the world
What makes a good feature?

- One that accounts for a **systematic** grammatical distinction
What makes a good feature?

- One that accounts for a *systematic* grammatical distinction
- One that fits within the overall grammatical system (doesn’t contradict other distinctions)
What makes a good feature?

- One that accounts for a *systematic* grammatical distinction
- One that fits within the overall grammatical system (doesn’t contradict other distinctions)
- One that is not too out-of-line with the feature systems in the known languages of the world
Some German data

...the dog...

Der Hund ist ...
The dog is ...
Some German data

...the dog...

Der Hund ist ...
The dog is ...

... seht den Hund
... sees the dog
Some German data

...the dog...

Der Hund ist ...
The dog is ...

... seht den Hund
... sees the dog

die Hunde sind ...
the dogs are ...
Some German data

...the dog...

Der Hund ist ...  
The dog is ...

... seht den Hund
... sees the dog

die Hunde sind ...
the dogs are ...

... geht mit dem Hund
... goes with the dog
Some German data

...the dog...

Der Hund ist ...
The dog is ...

... seht den Hund
... sees the dog

die Hunde sind ...
the dogs are ...

... geht mit dem Hund
... goes with the dog

... über den Hund
... about the dog
An analysis

subject position

der   Hund  
the    dog   
‘the dog’
An analysis

subject position

<table>
<thead>
<tr>
<th>der</th>
<th>Hund</th>
<th>the.NOM</th>
<th>dog</th>
<th>‘the dog’</th>
</tr>
</thead>
</table>
An analysis

subject position

<table>
<thead>
<tr>
<th>der</th>
<th>Hund</th>
</tr>
</thead>
<tbody>
<tr>
<td>the.NOM</td>
<td>dog</td>
</tr>
<tr>
<td>‘the dog’</td>
<td></td>
</tr>
</tbody>
</table>

subject position, plural

<table>
<thead>
<tr>
<th>die</th>
<th>Hunde</th>
</tr>
</thead>
<tbody>
<tr>
<td>the.NOM</td>
<td>dog.PL</td>
</tr>
<tr>
<td>‘the dogs’</td>
<td></td>
</tr>
</tbody>
</table>
### An analysis

<table>
<thead>
<tr>
<th>subject position</th>
<th>subject position, plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>der Hund</td>
<td>die Hunde</td>
</tr>
<tr>
<td>the.NOM dog</td>
<td>the.NOM.PL dog.PL</td>
</tr>
<tr>
<td>‘the dog’</td>
<td>‘the dogs’</td>
</tr>
</tbody>
</table>

Num: PL, SG
### An analysis

<table>
<thead>
<tr>
<th><strong>subject position</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>der Hund</td>
</tr>
<tr>
<td>the.NOM dog</td>
</tr>
<tr>
<td>‘the dog’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>object position</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>... den Hund</td>
</tr>
<tr>
<td>... the dog</td>
</tr>
<tr>
<td>‘... the dog’</td>
</tr>
</tbody>
</table>

**Num:** PL, SG
An analysis

subject position

<table>
<thead>
<tr>
<th>der</th>
<th>Hund</th>
</tr>
</thead>
<tbody>
<tr>
<td>the.NOM dog</td>
<td></td>
</tr>
</tbody>
</table>

‘the dog’

object position

<table>
<thead>
<tr>
<th>... den</th>
<th>Hund</th>
</tr>
</thead>
<tbody>
<tr>
<td>... the.ACC dog</td>
<td></td>
</tr>
</tbody>
</table>

‘... the dog’

Num: PL, SG
An analysis

**subject position**

<table>
<thead>
<tr>
<th>der</th>
<th>Hund</th>
</tr>
</thead>
<tbody>
<tr>
<td>the.NOM</td>
<td>dog</td>
</tr>
</tbody>
</table>

‘the dog’

**object position**

<table>
<thead>
<tr>
<th>... den</th>
<th>Hund</th>
</tr>
</thead>
<tbody>
<tr>
<td>... the.ACC</td>
<td>dog</td>
</tr>
</tbody>
</table>

‘... the dog’

Num: PL, SG
An analysis

<table>
<thead>
<tr>
<th>subject position</th>
</tr>
</thead>
<tbody>
<tr>
<td>der Hund</td>
</tr>
<tr>
<td>the.NOM dog</td>
</tr>
<tr>
<td>‘the dog’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>object position</th>
</tr>
</thead>
<tbody>
<tr>
<td>… den Hund</td>
</tr>
<tr>
<td>… the.ACC dog</td>
</tr>
<tr>
<td>‘… the dog’</td>
</tr>
</tbody>
</table>

Num: PL, SG
Case: NOM, ACC
Some more German data

...the cat...

Die Katze ist ...
‘The cat is ...
Some more German data

...the cat...

Die Katze ist ...
‘The cat is ...

... seht die Katze
‘... sees the cat
Some more German data

...the cat...

Die Katze ist ...
‘The cat is ...

... seht die Katze
‘... sees the cat

die Katze sind ...
the cats are ...
Some more German data

...the cat...

Die Katze ist ...
‘The cat is ...

... seht die Katze
‘... sees the cat

die Katze sind ...
the cats are ...

... geht mit der Katze
... goes with the cat
Some more German data

...the cat...

Die Katze ist ...
‘The cat is ...

... sieht die Katze
‘... sees the cat

die Katze sind ...
the cats are ...

... geht mit der Katze
... goes with the cat

... über die Katze
... about the cat
Feature interaction in German

German grammatical features

Consider the interactions of the German case, number and gender system:

<table>
<thead>
<tr>
<th>Case</th>
<th>Masc</th>
<th>Fem</th>
<th>Neut</th>
<th>PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom</td>
<td>der</td>
<td>die</td>
<td>das</td>
<td>die</td>
</tr>
<tr>
<td>Gen</td>
<td>des</td>
<td>der</td>
<td>des</td>
<td>der</td>
</tr>
<tr>
<td>Dat</td>
<td>dem</td>
<td>der</td>
<td>dem</td>
<td>den</td>
</tr>
<tr>
<td>Acc</td>
<td>den</td>
<td>die</td>
<td>das</td>
<td>die</td>
</tr>
</tbody>
</table>

Case: Nom, Gen, Dat, Acc
Gender: Masc, Fem, Neut
Number: PL, SG
Features and verb classes

**Example**

<table>
<thead>
<tr>
<th>Die</th>
<th>Katze</th>
<th>sieht</th>
<th>den Hund</th>
</tr>
</thead>
<tbody>
<tr>
<td>the.NOM.FEM.SG</td>
<td>cat.3.FEM.SG</td>
<td>see.3.SG</td>
<td>the.ACC.MASC.SG dog.3.MASC.SG</td>
</tr>
</tbody>
</table>

‘the cat sees the dog’
Features and verb classes

Example

Die Katze sieht den Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.ACC.MASC.SG dog.3.MASC.SG
‘the cat sees the dog’

*Die Katze sieht dem Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.DAT.MASC.SG dog.3.MASC.SG

Conclusion

Some verbs assign the accusative case (ACC) to their objects, while some assign the dative case (DAT). There are at least two distinct verb classes in German.
Features and verb classes

Example

Die Katze sieht den Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.ACC.MASC.SG dog.3.MASC.SG
‘the cat sees the dog’

*Die Katze sieht dem Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.DAT.MASC.SG dog.3.MASC.SG

Die Katze hilft dem Hund
the.NOM.FEM.SG cat.3.FEM.SG help.3.SG the.DAT.MASC.SG dog.3.MASC.SG
‘the cat helps the dog’
Features and verb classes

Example

Die Katze sieht den Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.ACC.MASC.SG dog.3.MASC.SG
‘the cat sees the dog’

*Die Katze sieht dem Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.DAT.MASC.SG dog.3.MASC.SG

Die Katze hilft dem Hund
the.NOM.FEM.SG cat.3.FEM.SG help.3.SG the.DAT.MASC.SG dog.3.MASC.SG
‘the cat helps the dog’

*Die Katze hilft den Hund
the.NOM.FEM.SG cat.3.FEM.SG help.3.SG the.ACC.MASC.SG dog.3.MASC.SG
Features and verb classes

Example

Die Katze sieht den Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.ACC.MASC.SG dog.3.MASC.SG
‘the cat sees the dog’

Die Katze hilft dem Hund
the.NOM.FEM.SG cat.3.FEM.SG help.3.SG the.DAT.MASC.SG dog.3.MASC.SG
‘the cat helps the dog’
Features and verb classes

**Example**

Die Katze *sieht* den Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.ACC.MASC.SG dog.3.MASC.SG
‘the cat sees the dog’

Die Katze *hilft* dem Hund
the.NOM.FEM.SG cat.3.FEM.SG help.3.SG the.DAT.MASC.SG dog.3.MASC.SG
‘the cat helps the dog’
### Example

<table>
<thead>
<tr>
<th>German</th>
<th>English</th>
<th>Case</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Die</td>
<td>Die</td>
<td>Katze</td>
<td>Katze</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sieht</td>
<td>den</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dog.3.MASC.SG</td>
<td>Hund</td>
</tr>
<tr>
<td></td>
<td>'the cat sees the dog'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>German</th>
<th>English</th>
<th>Case</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Die</td>
<td>Die</td>
<td>Katze</td>
<td>Katze</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hilft</td>
<td>dem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dog.3.MASC.SG</td>
<td>Hund</td>
</tr>
<tr>
<td></td>
<td>'the cat helps the dog'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Features and verb classes

Example

Die Katze sieht den Hund
the.NOM.FEM.SG cat.3.FEM.SG see.3.SG the.ACC.MASC.SG dog.3.MASC.SG
‘the cat sees the dog’

Die Katze hilft dem Hund
the.NOM.FEM.SG cat.3.FEM.SG help.3.SG the.DAT.MASC.SG dog.3.MASC.SG
‘the cat helps the dog’

Conclusion

Some verbs assign the accusative case (ACC) to their objects, while some assign the dative case (DAT). There are at least two distinct verb classes in German.
Verbs do funny things

(1) a. I’ll spray that wall with paint.
    b. I’ll spray paint on that wall.

(2) a. I’ll fill the cart with bricks.
    b. *I’ll fill bricks into the cart.

(3) a. Bill slept the day away.
    b. *Bill arrived the day away.
Tying verb classes to reality

Activities vs. Achievements

(4) a. John climbed the mountain for four hours.
    b. John climbed the mountain in four hours.

(5) a. * John reached the summit for four hours.
    b. John reached the summit in four hours.
Tying verb classes to reality

<table>
<thead>
<tr>
<th>Activities vs. Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6) a. John climbed the mountain for four hours.</td>
</tr>
<tr>
<td>b. John climbed the mountain in four hours.</td>
</tr>
<tr>
<td>(7) a. * John reached the summit for four hours.</td>
</tr>
<tr>
<td>b. John reached the summit in four hours.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>climb, sleep, eat, fish, run, play</td>
</tr>
</tbody>
</table>
Activities happen over an extended time period.
Tying verb classes to reality

### Activities vs. Achievements

**Activities**

- climb, sleep, eat, fish, run, play

Activities happen over an extended time period.

**Achievements**

- reach, win, die, got X

Achievements happen in a very short time-span (nearly instantly).

(8) a. John climbed the mountain for four hours.
    b. John climbed the mountain in four hours.

(9) a. * John reached the summit for four hours.
    b. John reached the summit in four hours.