Lexicon Formalisms

LFG lexicon

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(most slides from Detmar Meurers’ Grammar Formalism course of summer 2014)
(and Mary Dalrymple 2006 respectively)

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Outline

LFG: basics

C-structure

F-structure

Grammar

Constraints, Templates, Rules
Outline

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Motivation for LFG

LFG = lexical functional grammar

- *Lexical* = (not transformational) richly structured lexicon, where relations between, e.g., verbal alternations, are stated

- *Functional* = (not configurational) abstract grammatical functions like subject and object are primitives, i.e., not defined by the phrase structure configurations
LFG in a nutshell

LFG (minimally) distinguishes two kinds of representation:

- **c-structure** (constituent structure):
  overt linear and hierarchical organization of words into phrases

- **f-structure** (functional structure):
  abstract functional organization of the sentence, explicitly representing syntactic predicate-argument structure and functional relations

These are two separate levels of representation and formalisms: trees (c-structure) and attribute-value matrices (f-structure). (A range of other levels have been proposed, e.g., A-structure and $\sigma$-structure.)
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Part I: C-structure

C-structure corresponds to a fairly traditional notion of phrase structure.

- X-Bar Theory: heads with complements, adjuncts, specifier
- Categories: lexical (N, P, V, A, Adv) and functional (I, C) categories—not universally fixed
Part I: C-structure

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```
kogda rodilsja Lermontov?
when born Lermontov
‘When was Lermontov born?’
```
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Part II: F-structure

- F-structure maps more closely to meaning and encodes abstract grammatical relations like subject and object as *primitives*, i.e. not reducible to anything else (e.g., tree structure).
- Categories like subject and object are cross-linguistic → languages vary less in their f-structure
- F-structures are attribute-value-matrices (AVMs)
Grammatical functions - Attributes

- **Governable functions**: SUBJ, OBJ, OBJ2, COMP, XCOMP, OBLθ
  - A predicate can govern these functions, i.e., subcategorize for them.

- **Non-governable functions**: ADJ, XADJ
  - **ADJ**: David devoured a sandwich yesterday.
  - **XADJ**: Having opened the window, David took a deep breath.

Topic-oriented languages (e.g., Russian) also include discourse functions TOPIC, FOCUS.
F-structure - Example
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Grammar rules

- C-structure rules annotated by F-structure constraints (using *ups* and *downs*)
Example grammar

Grammar Rules

(Kaplan & Bresnan 1995)

(26)  a.  \[ S \rightarrow NP \quad VP \]
\[ (↑SUBJ) = ↓ \quad ↑ = ↓ \]

b.  \[ NP \rightarrow Det \quad N \]
\[ ↑ = ↓ \quad ↑ = ↓ \]

c.  \[ VP \rightarrow V \quad NP \quad NP \]
\[ ↑ = ↓ \quad (↑OBJ) = ↓ \quad (↑OBJ2) = ↓ \]
## Example grammar

### Lexicon

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Det</th>
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</tr>
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</table>
| a | a | (↑SPEC) = A  
   |   | (↑NUM) = SG  |
| b | girl | (↑NUM) = SG  
    |   | (↑PRED) = 'girl'  |
| c | handed | (↑TENSE) = PAST  
    |   | (↑PRED) = 'hand<(↑SUBJ), (↑OBJ), (↑OBJ2)>'  |
| d | the | (↑SPEC) = THE  |
| e | baby | (↑NUM) = SG  
    |   | (↑PRED) = 'baby'  |
| f | toy | (↑NUM) = SG  
    |   | (↑PRED) = 'toy'  |
Example grammar

A sentence licensed by the grammar

\[
\begin{array}{c}
\text{f}_1: S \\
\text{f}_2: NP \\
\text{Det} \quad A \\
\text{N} \quad \text{girl} \\
\text{f}_3: VP \\
\uparrow = \downarrow \\
\text{f}_4: NP \\
\uparrow\downarrow \\
\text{Det} \quad \text{THE} \\
\text{N} \quad \text{the} \\
\text{f}_5: NP \\
\uparrow\downarrow \\
\text{Det} \quad \text{a} \\
\text{N} \quad \text{toy} \\
\end{array}
\]
Example grammar

The resulting F-structure

\[
\begin{align*}
\text{SUBJ} & \quad f_2: \\
& \quad \begin{cases} 
\text{SPEC} & \text{A} \\
\text{NUM} & \text{SG} \\
\text{PRED} & \text{'girl'}
\end{cases} \\
\text{TENSE} & \quad \text{PAST} \\
\text{PRED} & \quad \text{hand } <(\uparrow\text{SUBJ}), (\uparrow\text{OBJ}), (\uparrow\text{OBJ2})> \\

\text{OBJ} & \quad f_4: \\
& \quad \begin{cases} 
\text{SPEC} & \text{THE} \\
\text{NUM} & \text{SG} \\
\text{PRED} & \text{'baby'}
\end{cases} \\
\text{OBJ2} & \quad f_5: \\
& \quad \begin{cases} 
\text{SPEC} & \text{A} \\
\text{NUM} & \text{SG} \\
\text{PRED} & \text{'toy'}
\end{cases}
\end{align*}
\]
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Lexical constraints

- **John**
  - \((g \text{ PRED}) = 'JOHN'\)
  - \((g \text{ NUM}) = \text{SG}\)

- **runs**
  - \((f \text{ PRED}) = 'RUN<\text{SUBJ}>'\)
  - \((f \text{ SUBJ CASE}) = \text{NOM}\)
  - \((f \text{ SUBJ NUM}) = \text{SG}\)
(Lexical) templates

\[ CN = (\^ NUM)=SG \\
\quad (\^ DEF). \]

\[ \text{girl N} \star (\^ PRED)='GIRL' @CN. \]

\[ \text{girl N} \star (\^ PRED)='GIRL' \\
\quad \{ (\^ NUM)=SG \\
\quad (\^ DEF) \\
\quad \mid (\^ NUM)=PL \}. \]
(Lexical) templates

\[
\begin{align*}
CN(P) &= (^\text{PRED}) = 'P' \\
&\quad (^\text{NUM}) = \text{SG} \\
&\quad (^\text{DEF}).
\end{align*}
\]

girl N * @(CN GIRL).

\[
\begin{align*}
\text{INTRANS}(P) &= (^\text{PRED}) = 'P<(^\text{SUBJ})>'. \\
\text{TRANS}(P) &= (^\text{PRED}) = 'P<(^\text{SUBJ}) (^\text{OBJ})>'. \\
\text{OPTTRANS}(P) &= \{ @(\text{INTRANS} P) | @(\text{TRANS} P) \}.
\end{align*}
\]
Lexical rules

Example: passivization

LFG’s basic grammatical functions allow us to do passives in just one step, which all happens in the lexicon. In LFG there is no syntactic component to passives. Instead there is a simple lexical change associated with the passive morphology:

21) a) \textit{kiss} V \quad (\uparrow\text{PRED}) = \textit{kiss} < (\uparrow\text{SUBJ}), (\uparrow\text{OBJ})>

\quad +en

\quad \downarrow \quad \downarrow

\quad b) \textit{kissed}_{\text{pass}} V \quad (\uparrow\text{PRED}) = \textit{kiss} < \emptyset \quad (\uparrow\text{SUBJ}) >$

When the lexical entry in (21b) is inserted into a c-structure, the original object is directly placed into the subject position. There is no movement.

(5) \quad \text{SUBJ} \rightarrow \text{OBI}_{ag}

\quad \text{OBJ} \rightarrow \text{SUBJ}

\quad (\uparrow\text{PASSIVE}) =_c +