Ling 566
Oct 19, 2010
How the Grammar Works
Overview

• What we’re trying to do
• The pieces of our grammar
• Two extended examples
• Reflection on what we’ve done, what we still have to do
What We’re Trying To Do

• Objectives
  • Develop a theory of knowledge of language
  • Represent linguistic information explicitly enough to distinguish well-formed from ill-formed expressions
  • Be parsimonious, capturing linguistically significant generalizations.

• Why Formalize?
  • To formulate testable predictions
  • To check for consistency
  • To make it possible to get a computer to do it for us
How We Construct Sentences

• The Components of Our Grammar
  • Grammar rules
  • Lexical entries
  • Principles
  • Type hierarchy (very preliminary, so far)
  • Initial symbol (S, for now)

• We combine constraints from these components.

• Q: What says we have to combine them?
An Example

A cat slept.

• Can we build this with our tools?

• Given the constraints our grammar puts on well-formed sentences, is this one?
Lexical Entry for \( a \)

- Is this a fully specified description?
- What features are unspecified?
- How many word structures can this entry license?
Lexical Entry for *cat*

- Which feature paths are abbreviated?
- Is this a fully specified description?
- What features are unspecified?
- How many word structures can this entry license?
Effect of Principles: the SHAC

\[
\begin{array}{c}
\text{word} \\
\langle \text{cat} , \rangle \\
\text{SYN} \\
\text{VAL} \\
\text{SEM} \\
\text{HEAD} \\
\text{AGR} \quad \text{[3sing GEND neut]} \\
\text{SPR} \quad \text{[AGR COUNT + INDEX k]} \\
\text{COMPS} \quad \langle \rangle \\
\text{MODE} \quad \text{ref} \\
\text{INDEX} \quad k \\
\text{RESTR} \quad \langle \text{RELN cat} \rangle \\
\end{array}
\]
Description of Word Structures for cat

\[
\begin{align*}
\text{word} \ & \ \text{HEAD} \\
\text{noun} \ & \ \text{AGR} \ 3s\text{ing} \\
\text{GEND} \ & \ \text{neut} \\
\text{D} \ & \ \text{AGR} \ 2 \\
\text{COUNT} \ & \ + \\
\text{INDEX} \ & \ k \\
\text{COMPS} \ & \ \langle \rangle \\
\text{MOD} \ & \ \langle \rangle \\
\text{MODE} \ & \ \text{ref} \\
\text{INDEX} \ & \ k \\
\text{RESTR} \ & \ \langle \text{RELN cat} \rangle \\
\text{INSTANCE} \ & \ k \\
\end{align*}
\]
Description of Word Structures for \( a \)
Building a Phrase

[ ]

[ ]    [ ]
Constraints Contributed by Daughter Subtrees
Constraints Contributed by the Grammar Rule
A Constraint Involving the SHAC

[phrase
  SYN [ VAL [ SPR ⟨⟩]]]
Effects of the Valence Principle
Effects of the Head Feature Principle

[Diagram of syntactic and semantic structures with annotations and features for phrases, words, and sentences.]
Effects of the Semantic Inheritance Principle

[Diagram of syntactic and semantic structures with annotations for phrase, word, and specific semantically inherited elements such as head, val, sem, mode, index, restr, syn, and agr.

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Effects of the Semantic Compositionality Principle

phrase

HEAD 6
SYN
VAL
COMPS 3
MOD 4

SEM
INDEX k
RESTR A ⊕ B

word
det

HEAD
AGR 2
COUNT +
COMPS ⟨ ⟩
SPR ⟨ ⟩
MOD ⟨ ⟩

SEM
INDEX k
RESTR a BV k

word
noun

HEAD 6
AGR 2
3sing
COMP S 3 ⟨ ⟩
MOD 4 ⟨ ⟩

SEM
INDEX k
RESTR B ⟨ RELN cat INSTANCE k ⟩
Is the Mother Node Now Completely Specified?

```
phrase
  SYN
  HEAD 6
  VAL
  COMPS [3]
  SPR [⟨⟩]
  MOD [4]

SEM
  MODE 8
  INDEX k
  RESTR [A ⊕ B]

word
  SYN
  HEAD [det 2]
  AGR 2
  COUNT +
  VAL
  COMPS [⟨⟩]
  SPR [⟨⟩]
  MOD [⟨⟩]
  MODE none
  INDEX k
  RESTR [RELN a BV k]

word
  SYN
  HEAD [noun 6]
  AGR 2
  3sing
  GEND neut
  VAL
  COMPS [3⟨⟩]
  SPR [⟨⟩]
  MOD [4⟨⟩]
  MODE 8
  INDEX k
  RESTR [RELN cat INSTANCE k]
```
Lexical Entry for *slept*

```
<slept,>

word

SYN

HEAD verb

VAL

SPR ⟨AGR 9

CASE nom]⟩

COMPS ⟨⟩

MOD ⟨⟩

INDEX s₁

MODE prop

SEM

RESTR ⟨RELN sleep

SIT s₁

SLEEPER m⟩, …

NPₘ>
Another Head-Specifier Phrase

Key

- HSR
- SHAC
- Val Prin
- HFP
- SIP
- SCP

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Is this description fully specified?
Does the top node satisfy the initial symbol?
RESTR of the S node

\[ \langle \begin{bmatrix} \text{RELN} & a \\ \text{BV} & k \end{bmatrix}, \begin{bmatrix} \text{RELN} & \text{cat} \\ \text{INST} & k \end{bmatrix}, \begin{bmatrix} \text{RELN} & \text{sleep} \\ \text{SIT} & s_1 \\ \text{SLEEPER} & k \end{bmatrix}, \ldots \rangle \]
Another Example

```
S
  /
 /  
NP NP  VP 
  D  NOM  V  ADV
   the   photos disappeared yesterday
      P  NP
        D  N
           the suspect
          of

```
Head Features from Lexical Entries

```
S
  /   \
 NP   VP
   /    \
 [HEADdet] NOM [HEADverb] [HEADadverb]
   |        |        |
   the     photos disappeared yesterday
       |        |
       [HEADnoun] [HEADprep] [HEADnoun]
   |        |
   of      the suspect
```
the photos of the suspect disappeared yesterday.
Valence Features:
Lexicon, Rules, and the Valence Principle

Key
- Lexicon
- Val. Prin.
- Rules

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the photos of the suspect disappeared yesterday
Two Semantic Features: the Lexicon & SIP

```
the [INDEX j] of photos [INDEX k] of the [INDEX k] suspect [INDEX s] disappeared yesterday
```

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RESTR Values and the SCP

\[ A \oplus B \oplus C \oplus D \oplus E \oplus F \oplus G \]

\[ A \oplus B \oplus C \oplus D \oplus E \]

\[ B \oplus C \oplus D \oplus E \]

\[ C \oplus D \oplus E \]

\[ D \oplus E \]

\[ F \oplus G \]

\[ \langle [\text{RELN the BV } j] \rangle \]

\[ \langle [\text{RELN the BV } k] \rangle \]

\[ \langle [\text{RELN suspect INST } k] \rangle \]

\[ \langle [\text{RELN disap. SIT } s_3 \text{ D-ER } j] \rangle \]

\[ \langle [\text{RELN yest. ARG } s_3] \rangle \]

\[ \text{the} \]

\[ \text{photos} \]

\[ \text{of} \]

\[ \text{disappeared} \]

\[ \text{yesterday} \]
An Ungrammatical Example

What's wrong with this sentence?
An Ungrammatical Example

What's wrong with this sentence?
So what?
An Ungrammatical Example

The Valence Principle

\[ *S \]

\[ \text{NP} \quad \text{[CASE acc]} \]

\[ \text{them} \]

\[ \text{VP} \quad \text{[SPR} \quad \langle 1 \rangle \quad \text{]} \]

\[ \text{V} \]

\[ \text{sent} \]

\[ \text{[SPR} \quad \langle 1 \rangle \quad \text{NP[nom]} \rangle \]

\[ \text{NP} \quad \text{us} \]

\[ \text{NP} \quad \text{D} \quad \text{N} \]

\[ \text{a} \quad \text{letter} \]
An Ungrammatical Example

Head Specifier Rule

\[
*S
\]

\[
\text{NP}[	ext{CASE acc}]
\]

\[
\text{them}
\]

\[
\text{VP}[	ext{SPR} \langle 1 \rangle]
\]

\[
\text{V}
\]

\[
\text{sent}
\]

\[
\text{NP}[\text{nom}]
\]

\[
\text{NP}
\]

\[
\text{us}
\]

\[
\text{D}
\]

\[
\text{N}
\]

\[
a
\]

\[
\text{letter}
\]
Exercise in Critical Thinking

• Our grammar has come a long way since Ch 2, as we've added ways of representing different kinds of information:
  • generalizations across categories
  • semantics
  • particular linguistic phenomena: valence, agreement, modification

• What else might we add? What facts about language are as yet unrepresented in our model?
Overview

• What we’re trying to do
• The pieces of our grammar
• Two extended examples
• Reflection on what we’ve done, what we still have to do
• Next time: Binding Theory