Ling 566
Oct 14, 2014
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
• Reading questions
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
Description of Word Structures for *cat*
Description of Word Structures for a

word

SYN

HEAD

det

AGR 3sing

COUNT +

VAL

COMPS ⟨⟩

SPR ⟨⟩

MOD ⟨⟩

SEM

MODE none

INDEX j

RESTR ⟨RELN a⟩

BV ⟨⟩

j

a
Building a Phrase

[ ]

[]    []
Constraints Contributed by Daughter Subtrees
Constraints Contributed by the Grammar Rule

[phrase
  SYN [ VAL [ SPR ⟨⟩]]]
A Constraint Involving the SHAC

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

```
phrase
  SYN
  VAL
    COMPS ⟨⟩
    MOD ⟨⟩

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

word
  HEAD
  noun
    AGR 2
    3sing
    GEND neut
  COMPS ⟨⟩
  SPR ⟨⟩
  MOD ⟨⟩
  MODE ref
  INDEX k
  SEM
  RESTR RELN INSTANCE k
```
Effects of the Head Feature Principle
Effects of the Semantic Inheritance Principle

phrase

SYN

val

comps

mode

index

word
det

head

agr

count

mod

word

noun

head

agr

3sing

gend

neut

word

mode

index

ref

rest

reln

inst

Effects of the Semantic Compositionality Principle
Is the Mother Node Now Completely Specified?

```
phrase

[HEAD 6]

[SYN]

[VAL]

[SPR 〈 〉]

[COMPS 3]

[MOD 4]

[SEM]

[MODE 8]

[INDEX k]

[RESTR A ⊕ B]

word

[HEAD det]

[AGR 2]

[COUNT +]

[COMPS 〈 〉]

[SPR 〈 〉]

[MOD 〈 〉]

[SEM]

[MODE none]

[INDEX k]

[RESTR A]

[RELN a BV k]

[RESTR B]

[RELN cat INSTANCE k]

word

[HEAD noun]

[AGR 2]

[3sing]

[GINED neut]

[COMPS 3〈 〉]

[MOD 4〈 〉]

[SEM]

[MODE ref]

[INDEX k]

[RESTR B]

[RELN cat]

[INSTANCE k]

```
Lexical Entry for *slept*

\[
\text{word} \begin{bmatrix}
\text{HEAD} & \text{verb} \\
\text{SPR} & \langle \text{AGR} \begin{bmatrix} 9 \\ \text{CASE} \begin{bmatrix} \text{nom} \end{bmatrix} \end{bmatrix} \rangle \\
\text{COMPS} & \langle \rangle \\
\text{MOD} & \langle \rangle \\
\text{INDEX} & s_1 \\
\text{MODE} & \text{prop}
\end{bmatrix}
\text{SEM} \begin{bmatrix}
\text{RESTR} & \langle \text{RELN} \begin{bmatrix} \text{sleep} \end{bmatrix} \rangle \\
\text{SIT} & s_1 \\
\text{SLEEPER} & m
\end{bmatrix}
\]
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

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

S

NP

D
the

NOM

N
photos

PP

P
of

NP

D
the

N
suspect

VP

V
disappeared

ADV
yesterday
Head Features from Lexical Entries

```
S
  NP  VP
    [HEADdet]  [HEADnoun]  [HEADverb]  [HEADadverb]
      the  NOM  disappeared  yesterday
          [HEADnoun]  PP
            photos  [HEADprep]
                [HEADdet]  NP
                  of  [HEADdet]  [HEADnoun]
                    the  suspect
```
Head Features from Lexical Entries, plus HFP

[HEAD[4]]

[HEAD[1]

[HEAD[1]noun] photos

[HEAD[2]prep] of


[HEAD adverb] yesterday

[HEAD det] the
Valence Features:
Lexicon, Rules, and the Valence Principle

Key

Lexicon  Val.  Rules
Required Identities: Grammar Rules

S

[NP [D the [N NOM [SPR 2] [COMPS 3] photos]]]


[VP [V disappeared [ADV [MOD [6] yesterday]] [SPR 1]]]
Two Semantic Features: the Lexicon & SIP

The photos of the suspect disappeared yesterday.
RESTR Values and the SCP
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

NP

[CASE acc]

them

VP

[SPR ⟨⟩ ]

V

[sent]

[SPR ⟨⟩ NP[nom]]

NP

us

NP

D

N

a

letter
An Ungrammatical Example

Head Specifier Rule

*S

NP

[CASE acc]

them

VP

[SPR ⟨1⟩]

V

[sent]

NP

[SPR ⟨1NP[nom]⟩]

us

NP

D

N

a

letter

ccontradiction

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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
• Reading questions
• Next time: Binding Theory & Imperatives
Reading Questions

• Do we have to understand 6.3 (the squiggly bits)?

• "Unless the rule says otherwise, the mother's values for the VAL features are identical to those of the head daughter?" Which rule?

• If the HCR 'overrides' the Valence Principle for COMPS, why have COMPS be part of the Valence Principle at all?
Reading Questions

• Why do English nouns need a value for CASE, if they never inflect for it?

• How come we say that both 'a letter' and 'us' in 'They sent us a letter' are [CASE acc] when they plainly play different roles with respect to the verb semantically?

• Why not give send the COMPS value < NP ( PP | NP ) > ?
Reading Questions

• Why is MOD a general val-cat feature when we only use it for adj, prep and adv? Even section 5.6 where it is introduced indicates that it is only for those 3 values, so couldn't it create another sub-group of pos like AGR does for verb, noun, and det?

• Is it correct that all the attributes of RESTR structures don't have to be filled for sentence to be acceptable? If so how do we derive meaning of RESTR structures with missing arguments? Do we ignore them?
For the case of the word *sent*, the example says that even though *sent* doesn't show any marking for plurality, etc..., we still have to specify that it is 3rd person plural because the specifier noun is 3rd person plural. Why is this? Would the two features not agree with each other if we just put no agreement marking on the verb? Or is the grammar saying that there are actually several different instances of the word 'sent' and that this specific instance is 3rd person plural in order to agree with the noun?
Reading Questions

• I'm also a little bit confused on when we can underspecify the feature structures, and what we can leave unspecified when we can.

• How is top-down processing different from bottom-up processing?

• How does our grammar handle ambiguous sentences like *This is a minute hand*?
Reading Questions

• In section 6.3, the book expresses a formalism that appears a bit more like a mathematical theorem. With this new formalism, can we begin to infer any type of precedence on the rules? I believe that the book has done an excellent job of presenting HPSG in a manner that makes many of its conclusions seem intuitive. Yet, with a mathematical background, this intuition makes me a bit nervous. When I see the new formalism presented in chapter 6, I suspect that this intuition will be insufficient as the problem space becomes more complex. Therefore, I am wondering if there is a preferred order in which the grammar rules and principles can be applied. In other words, is the order of presentation in section 6.3.6 any indication of the order that we should perform the tests of (39), (40), ... , (45)?