Ling 566
Nov 2, 2010
Lexical Rules
Overview

• How lexical rules fit in
• Three types of lexical rules, constraints
• Example: Plural noun lexical rule
• Advice on writing lexical rules
• Constant lexemes
• ARG-ST & ARP
• The feature FORM
Lexical Types & Lexical Rules

• Lexemes capture the similarities among *run*, *runs*, *running*, and *ran*

• The lexical type hierarchy captures the similarities among *run*, *sleep*, and *laugh*, among those and other verbs like *devour* and *hand*, and among those and other words like *book*.

• Lexical rules capture the similarities among *runs*, *sleeps*, *devours*, *hands*, ...
Parsimony & Plausibility

- Lexical rules capture **productive** generalizations.
- There may be some ‘precompiling’ going on as well.
Three Kinds of Lexical Rules

• Inflectional: lexeme to word
  Examples?

• Derivational: lexeme to lexeme
  Examples?

• Post-Inflectional: word to word
  (Chapters 11, 13, 14)
Three Subtypes of $l$-rule

$l$-rule:

\[
\text{INPUT} \quad l\text{-sequence} \langle X, [\text{SEM } / 2] \rangle \\
\text{OUTPUT} \quad l\text{-sequence} \langle Y, [\text{SEM } / 2] \rangle
\]

$i$-rule:

\[
\text{INPUT} \quad \langle X, \begin{array}{c}
\text{lexeme} \\
\text{SYN } 3 \\
\text{ARG-ST } A
\end{array} \rangle \\
\text{OUTPUT} \quad \langle Y, \begin{array}{c}
\text{word} \\
\text{SYN } 3 \\
\text{ARG-ST } A
\end{array} \rangle
\]

$d$-rule:

\[
\text{INPUT} \quad \langle X, \begin{array}{c}
\text{lexeme} \\
\text{SYN } / 3
\end{array} \rangle \\
\text{OUTPUT} \quad \langle Y, \begin{array}{c}
\text{lexeme} \\
\text{SYN } / 3
\end{array} \rangle
\]

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Plural Noun LR

\[ i\text{-rule} \]

INPUT \( \langle 1, \text{cntn-lxm} \rangle \)

OUTPUT \( \langle F_{\text{NPL}}(1), \left[ \begin{array}{c} \text{word} \\ \text{SYN} \left[ \text{HEAD} \left[ \text{AGR} \left[ \text{NUM pl} \right] \right] \right] \end{array} \right] \rangle \)
Plural Noun LR with Inherited Constraints

\[ i\text{-rule} \]

INPUT \[ \langle 1, \rangle \]

OUTPUT \[ \langle F_{NPL}(\Pi), \rangle \]

\[ \begin{align*}
&\text{cntn-lxm} \\
&\text{word} \\
&\text{HEAD [AGR [NUM pl]]}
\end{align*} \]
Plural Noun LR with Inherited Constraints
Plural Noun LR with Inherited Constraints

\[ i-rule \]

INPUT \( \left\langle 1, \right\rangle \)

SEM 2
ARG-ST \( B \oplus C \)

cntn-lxm

OUTPUT \( \left\langle F_{NPL}(\Pi), \right\rangle \)

SEM 2
ARG-ST \( B \oplus C \)

\( F_{NPL}(\Pi) \)

HEAD [AGR [NUM pl]]
Plural Noun LR with Inherited Constraints

\[\text{i-rule}\]

\[\text{INPUT} \left\langle 1, \right\rangle\]

\[\text{SYN} \quad \text{3}\]

\[\text{SEM} \quad \text{2}\]

\[\text{ARG-ST} \quad \text{B} \oplus \text{C}\]

\[\text{OUTPUT} \left\langle \text{F}_{NPL}(\Pi), \right\rangle\]

\[\text{SYN} \quad \text{3}\]

\[\text{SEM} \quad \text{2}\]

\[\text{ARG-ST} \quad \text{B} \oplus \text{C}\]
Plural Noun LR with Inherited Constraints

\[ \text{i-rule} \]

INPUT \( \langle 1 \rangle \),

SYN \( 3 \)

VAL \( \langle \rangle \)

SEM \( 2 \)

ARG-ST \( B \oplus C \)

\[ \text{cntn-lxm} \]

\[ \text{HEAD} \]

\[ \text{SPR} \langle \text{DP} \rangle \]

\( \langle \text{MODE} / \text{ref} \rangle \)

\( B \oplus C \)

\[ \text{noun} \]

\[ \text{AGR} \]

\( 4 \)

\[ \text{PER} \]

\( 3 \text{rd} \)

\[ \text{COUNT} \]

\( + \)

\[ \text{AGR} \]

\( 4 \)

\[ \text{NUM} \]

\( \text{pl} \)

\[ \text{head} \]

\[ \text{VAL} \]

\[ \text{SPR} \]

\( B \oplus C \)

\[ \text{ARG-ST} \]

\( \langle \rangle \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

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\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

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\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)

\[ \text{SEM} \]

\( 2 \)

\( \langle \rangle \)

\[ \text{ARG-ST} \]

\( B \oplus C \)
Plural Noun LR with Inherited Constraints

\[ i-rule \]

**INPUT**
\[ \langle 1 \rangle, \]
\[ \begin{array}{c}
\text{SYN} \quad \text{3} \\
\text{VAL} \\
\text{SEM} \quad \text{2} \quad \text{[MODE / ref]} \\
\text{ARG-ST} \quad \text{B} \odot \text{C}
\end{array} \]

**cntn-lxm**
\[ \begin{array}{c}
\text{HEAD} \\
\text{AGR} \quad \text{4} \quad \text{[PER 3rd]} \\
\text{SPR} \quad \text{DP} \\
\text{COUNT} + \\
\text{AGR} \quad \text{4}
\end{array} \]

**OUTPUT**
\[ \langle F_{NPL}(\Pi) \rangle, \]
\[ \begin{array}{c}
\text{SYN} \quad \text{3} \\
\text{VAL} \\
\text{SEM} \quad \text{2} \\
\text{ARG-ST} \quad \text{B} \odot \text{C}
\end{array} \]
\[ \begin{array}{c}
\text{word} \quad \text{[AGR [NUM pl]]} \\
\text{HEAD} \\
\text{SPR} \quad \text{B} \odot \text{C} \\
\text{COMPS} \quad \text{[B]} \\
\text{C}
\end{array} \]
Practicalities - Applying Lexical Rules

- INPUT is a family of lexical sequences.
- OUTPUT is another family of lexical sequences.
  - ...usually a smaller family
  - ...usually a disjoint one
- The only differences between the families are those stipulated in the rule (or the rule’s type).
- Similarities are handled by the constraints on l-rule and its subtypes.
- If we’ve written the LRs correctly, nothing is left underconstrained.
Example: Lexical Entry for *cat*

\[
\langle \text{cat} \rangle \left[ \begin{array}{c}
\text{SEM} \\
\text{RESTR}
\end{array} \right] \left[ \begin{array}{c}
\text{INDEX} \\
\text{cntn-lxm}
\end{array} \right] \left[ \begin{array}{c}
\text{RELN} \\
\text{INST}
\end{array} \right] \langle \text{cat} \rangle
\]
Example: *cat*, with inheritance
Example: *cat*, with inheritance
Example: *cat*, with inheritance

\[
\langle \text{cntn-lxm} \rangle
\]

\[
\langle \text{HEAD} \rangle
\]

\[
\langle \text{VAL} \rangle
\]

\[
\langle \text{SEM} \rangle
\]

\[
\langle \text{ARG-ST} \rangle
\]
Example: *cat*, with inheritance
Plural Noun LR

\[ i\text{-rule} \]

INPUT \( \langle [1], \text{cntn-lxm} \rangle \)

OUTPUT \( \langle F_{NPL}([1]), [\text{word}\ [\text{SYN}\ [\text{HEAD}\ [\text{AGR}\ [\text{NUM}\ \text{pl}]])}] \rangle \)
Licensing *cats*

```
INPUT  \langle \Box \text{cat} \rangle

\begin{align*}
\text{i-rule} & \quad \text{cntn-lxm} \\
\text{SYN} & : 3 \\
\text{VAL} & : \text{SPR} \langle [\text{COUNT} +] \rangle \\
\text{SEM} & : 2 \\
\text{ARG-ST} & : \Box \langle X \rangle \oplus \Box \langle \rangle
\end{align*}

OUTPUT  \langle \text{FNPL} (\Box) \rangle

\begin{align*}
\text{SYN} & : 3 \\
\text{VAL} & : \text{SPR} \langle \text{COMPS} \rangle \\
\text{SEM} & : 2 \\
\text{ARG-ST} & : \Box \oplus \Box
\end{align*}
```
Three Subtypes of \( l \)-rule

\[
\text{\( l \)-rule : \[\begin{array}{l}
\text{INPUT} \quad l\text{-sequence}\langle X, [ \text{SEM} / 2] \rangle \\
\text{OUTPUT} \quad l\text{-sequence}\langle Y, [ \text{SEM} / 2] \rangle
\end{array}\]}
\]

\[
i\text{-rule : \[\begin{array}{l}
\text{INPUT} \quad \langle X, [\text{lexeme SYN 3 ARG-ST A}] \rangle \\
\text{OUTPUT} \quad \langle Y, [\text{lexeme SYN 3 ARG-ST A}] \rangle
\end{array}\]}
\]

\[
d\text{-rule : \[\begin{array}{l}
\text{INPUT} \quad \langle X, [\text{lexeme SYN / 3}] \rangle \\
\text{OUTPUT} \quad \langle Y, [\text{lexeme SYN / 3}] \rangle
\end{array}\]}
\]
**cats**: The Lexical Sequence
Practicalities -- Writing Lexical Rules

• Determine the type of the LR.

• Determine the class of possible inputs.

• Determine what should change.
  
  • If INPUT and OUTPUT values are identified (by default or otherwise) and only OUTPUT value is mentioned, then... information is added.
    (Lexical sequences incompatible with that value are not possible inputs)
  
  • If INPUT and OUTPUT values are identified by default, but different values are given on the INPUT and OUTPUT of the rule, then... information is changed.

  • If INPUT and OUTPUT values are identified by an inviolable constraint, but different values are given on the INPUT and OUTPUT of the rule, then... there is no well-formed output
Constant lexemes

• What kinds of words are constant lexemes in our grammar?
• Why do we need a rule for these words?
• What would be an alternative analysis?
• What keeps this from applying to, say, verb lexemes?
• Why is this an *i-rule*?
ARG-ST & ARP

• Given the ARP, what do we need to specify about the valence properties of words?
• Why isn’t the ARP a constraint on the type *lexeme*?
The Feature FORM

• Different inflected forms of verbs show up in different syntactic environments. Examples?

• These different forms are syntactically distinguished by the feature FORM, as assigned by lexical rules.

• FORM is also useful in our analyses of coordination and PP selection.
What rules these out?

• *Kim eat pizza.
• *Kim seems to eats pizza.
• *Dana helped Leslie pack and moved.
• *Kim relies for Sandy.
• *Dana walked and Kim.
Overview

• How lexical rules fit in
• Three types of lexical rules, constraints
• Example: Plural noun lexical rule
• Advice on writing lexical rules
• Constant lexemes
• ARG-ST & ARP
• The feature FORM