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
• Questions about homework?
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, ...
• 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 \( \mathit{l-rule} \)

\[ \mathit{l-rule} : \begin{bmatrix}
\text{INPUT} & \mathit{l-sequence} \langle X, [\text{SEM} / 2] \rangle \\
\text{OUTPUT} & \mathit{l-sequence} \langle Y, [\text{SEM} / 2] \rangle
\end{bmatrix} \]

\[ \mathit{i-rule} : \begin{bmatrix}
\text{INPUT} & \langle X, \begin{bmatrix}
\text{lexeme} \\
\text{SYN 3} \\
\text{ARG-ST A}
\end{bmatrix} \rangle \\
\text{OUTPUT} & \langle Y, \begin{bmatrix}
\text{word} \\
\text{SYN 3} \\
\text{ARG-ST A}
\end{bmatrix} \rangle
\end{bmatrix} \]

\[ \mathit{d-rule} : \begin{bmatrix}
\text{INPUT} & \langle X, \begin{bmatrix}
\text{lexeme} \\
\text{SYN / 3}
\end{bmatrix} \rangle \\
\text{OUTPUT} & \langle Y, \begin{bmatrix}
\text{lexeme} \\
\text{SYN / 3}
\end{bmatrix} \rangle
\end{bmatrix} \]
Plural Noun LR

\[
i\text{-rule}
\]

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

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

INPUT

\[ i\text{-rule} \]

\[
\begin{array}{c}
\text{cntn-lxm} \\
\text{HEAD} \\
\text{SYN} \\
\text{VAL} \\
\text{SEM} \\
\text{ARG-ST}
\end{array}
\]

\[
\begin{array}{c}
\text{noun} \\
\text{AGR} \\
3 \\
\text{PER} \\
3\text{rd}
\end{array}
\]

\[
\begin{array}{c}
\text{DP} \\
\text{SPR} \\
\text{COUNT} \\
\text{+}
\end{array}
\]

\[
\begin{array}{c}
\text{SEM} \\
\text{2}
\end{array}
\]

\[
\begin{array}{c}
\text{MODE} \\
\text{ref}
\end{array}
\]

\[
\begin{array}{c}
\text{B} \\
\text{⊕}
\end{array}
\]

\[
\begin{array}{c}
\text{word} \\
\text{HEAD} \\
\text{SYN} \\
\text{VAL} \\
\text{SEM} \\
\text{ARG-ST}
\end{array}
\]

\[
\begin{array}{c}
\text{AGR} \\
\text{NUM} \\
\text{pl}
\end{array}
\]

\[
\begin{array}{c}
\text{SPR} \\
\text{COMPS}
\end{array}
\]

\[
\begin{array}{c}
\text{B} \\
\text{C}
\end{array}
\]

\[
\begin{array}{c}
\text{B} \\
\text{⊕}
\end{array}
\]

OUTPUT

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

\[
\begin{array}{c}
\text{word} \\
\text{HEAD} \\
\text{SYN} \\
\text{VAL} \\
\text{SEM} \\
\text{ARG-ST}
\end{array}
\]

\[
\begin{array}{c}
\text{AGR} \\
\text{NUM} \\
\text{pl}
\end{array}
\]

\[
\begin{array}{c}
\text{SPR} \\
\text{COMPS}
\end{array}
\]

\[
\begin{array}{c}
\text{B} \\
\text{C}
\end{array}
\]

\[
\begin{array}{c}
\text{B} \\
\text{⊕}
\end{array}
\]
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 \textit{l-rule} and its subtypes.
- If we’ve written the LRs correctly, nothing is left underconstrained.
Example: Lexical Entry for *cat*

\[
\langle \text{cat}, \begin{bmatrix}
\text{cntn-lxm} \\
\text{SEM} \\
\text{RESTR}
\end{bmatrix} \begin{bmatrix}
\text{INDEX} & k \\
\text{RELN} & \text{cat} \\
\text{INST} & k
\end{bmatrix} \rangle
\]
Example: *cat*, with inheritance
Plural Noun LR

\[
\begin{align*}
&i\text{-rule} \\
\text{INPUT} &\quad \langle 1, \text{cntn-lxm} \rangle \\
\text{OUTPUT} &\quad \langle F_{NPL}(1), \begin{bmatrix} \text{word} \\ \text{SYN} [\text{HEAD} [\text{AGR} [\text{NUM pl}]]] \end{bmatrix} \rangle
\end{align*}
\]
Licensing cats

\[ \text{INPUT} \left\langle \begin{array}{l}
\text{cat}, \\
\text{SEM} 2 \\
\text{ARG-ST} \langle X \rangle \oplus C \rangle
\end{array} \right\rangle \]

\[ \text{OUTPUT} \left\langle F_{\text{NPL}}(\Pi) , \begin{array}{l}
\text{SYN} 3 \\
\text{SEM} 2 \\
\text{ARG-ST} 2 \oplus C
\end{array} \right\rangle \]
Three Subtypes of $l$-rule

$l$-rule

\[
\begin{align*}
l-rule: & \begin{bmatrix} \text{INPUT} & l-sequence & \langle X, [\text{SEM} / 2] \rangle \\ \text{OUTPUT} & l-sequence & \langle Y, [\text{SEM} / 2] \rangle \end{bmatrix} \\
i-rule: & \begin{bmatrix} \text{INPUT} & \langle X, \begin{bmatrix} \text{lexeme} & 3 \\ \text{ARG-ST} & A \end{bmatrix} \rangle \\ \text{OUTPUT} & \langle Y, \begin{bmatrix} \text{word} & 3 \\ \text{ARG-ST} & A \end{bmatrix} \rangle \end{bmatrix} \\
d-rule: & \begin{bmatrix} \text{INPUT} & \langle X, \begin{bmatrix} \text{lexeme} & 3 \end{bmatrix} \rangle \\ \text{OUTPUT} & \langle Y, \begin{bmatrix} \text{lexeme} & 3 \end{bmatrix} \rangle \end{bmatrix}
\end{align*}
\]
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?
Constant Lexeme LR

\[
\begin{bmatrix}
i-rule \\
\text{INPUT} & \langle 1, \text{const-lxm} \rangle \\
\text{OUTPUT} & \text{FIRST } \begin{bmatrix} 1 \end{bmatrix}
\end{bmatrix}
\]

- What keeps this from applying to, say, verb lexemes?
- Why is this an \textit{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?
• 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.
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