Ling 566
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Lexical Rules

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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

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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*, ...

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Parsimony & Plausibility

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

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Three Kinds of Lexical Rules

- Inflectional: *lexeme* to *word*

  Examples?

- Derivational: *lexeme* to *lexeme*

  Examples?

- Post-Inflectional: *word* to *word*
  (Chapters 11, 13, 14)

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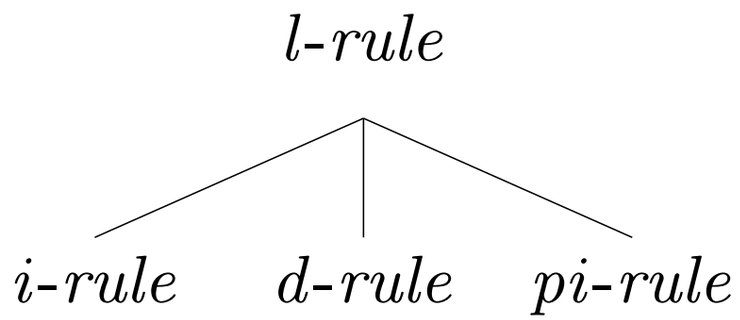
Three Subtypes of *l-rule*



$$\textit{l-rule}: \begin{bmatrix} \text{INPUT} & \textit{l-sequence}\left\langle \text{X} , [\ \text{SEM} \quad / \boxed{2}\ ] \right\rangle \\ \text{OUTPUT} & \textit{l-sequence}\left\langle \text{Y} , [\ \text{SEM} \quad / \boxed{2}\ ] \right\rangle \end{bmatrix}$$

$$\textit{i-rule}: \begin{bmatrix} \text{INPUT} & \left\langle \text{X} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad \boxed{3} \\ \text{ARG-ST} \quad \boxed{\text{A}} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y} , \begin{bmatrix} \textit{word} \\ \text{SYN} \quad \boxed{3} \\ \text{ARG-ST} \quad \boxed{\text{A}} \end{bmatrix} \right\rangle \end{bmatrix}$$

$$\textit{d-rule}: \begin{bmatrix} \text{INPUT} & \left\langle \text{X} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad / \boxed{3} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad / \boxed{3} \end{bmatrix} \right\rangle \end{bmatrix}$$

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Plural Noun LR

$$\left[\begin{array}{ll} \textit{i-rule} & \\ \text{INPUT} & \left\langle \boxed{1}\ ,\ \textit{cntn-lxm} \right\rangle \\ \text{OUTPUT} & \left\langle \text{F}_{NPL}(\boxed{1})\ ,\ \left[\begin{array}{ll} \textit{word} & \\ \text{SYN} & \left[\text{HEAD} \quad \left[\text{AGR} \quad \left[\text{NUM} \quad \text{pl}\right]\right]\right] \end{array}\right] \right\rangle \end{array}\right]$$

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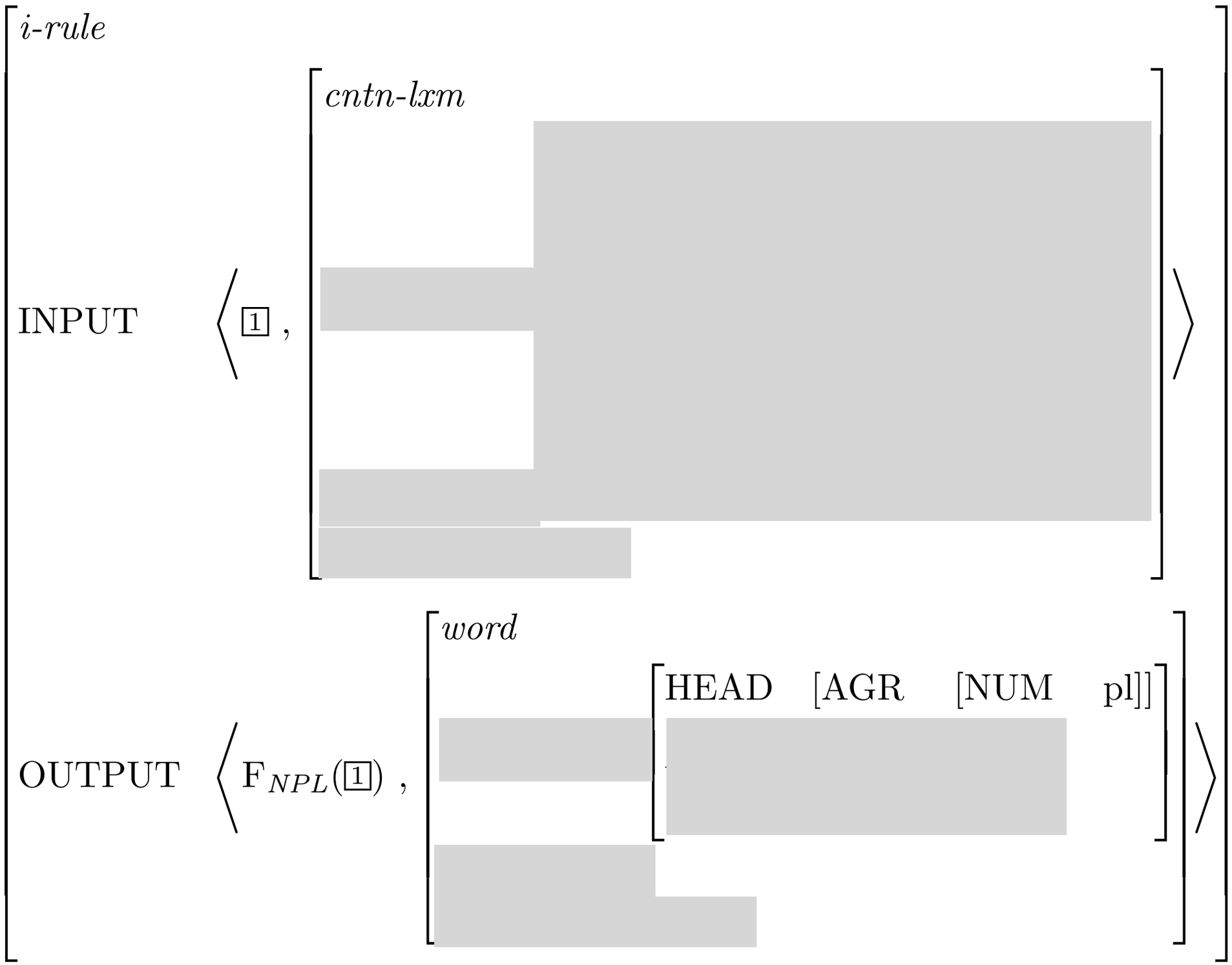
Plural Noun LR with Inherited Constraints



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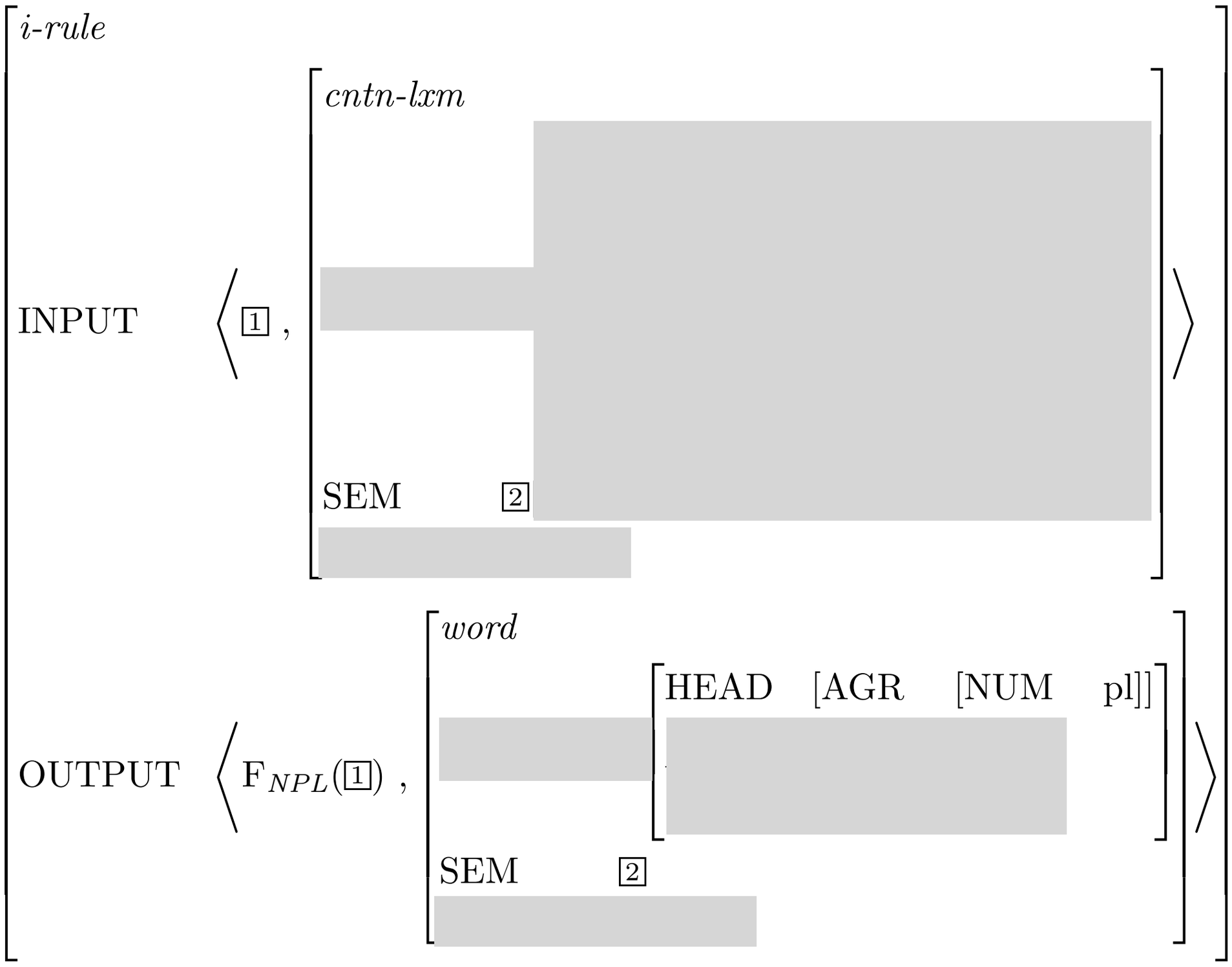
Plural Noun LR with Inherited Constraints



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Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{l}
\textit{cntn-lxm} \\
\\
\\
\text{SEM} \quad \boxed{2} \\
\text{ARG-ST} \quad \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \mathrm{F}_{NPL}(\boxed{1}), \left[\begin{array}{l}
\textit{word} \\
\\
\text{HEAD} \quad [\text{AGR} \quad [\text{NUM} \quad \text{pl}]] \\
\\
\text{SEM} \quad \boxed{2} \\
\text{ARG-ST} \quad \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle
\end{array}\right]
$$

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Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{ll}
\textit{cntn-lxm} & \\
\\
\text{SYN} & \boxed{3} \\
\\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll}
\textit{word} & \\
\\
\text{SYN} & \boxed{3}\left[\begin{array}{lll}\text{HEAD} & [\text{AGR} & [\text{NUM} \quad \text{pl}]]\end{array}\right] \\
\\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle
\end{array}\right]
$$

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Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{ll}
\textit{cntn-lxm} & \\
\text{SYN} & \boxed{3}\left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{4}[\text{PER} \quad \text{3rd}] \end{array}\right] \\
\text{VAL} & \left[\text{SPR} \quad \left\langle \left[\begin{array}{ll} & \text{DP} \\ \text{COUNT} & + \\ \text{AGR} & \boxed{4} \end{array}\right] \right\rangle\right]
\end{array}\right] \\
\text{SEM} & \boxed{2}[\text{MODE} \ / \ \text{ref}] \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle \\
\text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll}
\textit{word} & \\
\text{SYN} & \boxed{3}\left[\begin{array}{ll} \text{HEAD} & [\text{AGR} \quad [\text{NUM} \quad \text{pl}]] \end{array}\right] \\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle
\end{array}\right]
$$

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Plural Noun LR with Inherited Constraints

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\text{INPUT} \quad \left\langle \boxed{1}, \left[\begin{array}{ll}
\textit{cntn-lxm} & \\
\text{SYN} & \boxed{3}\left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{4}[\text{PER} \quad \text{3rd}] \end{array}\right] \\
\text{VAL} & \left[\text{SPR} \quad \left\langle \left[\begin{array}{ll} & \text{DP} \\ \text{COUNT} & + \\ \text{AGR} & \boxed{4} \end{array}\right] \right\rangle\right]
\end{array}\right] \\
\text{SEM} & \boxed{2}[\text{MODE} \ / \ \text{ref}] \\
\text{ARG-ST} & \boxed{\text{B}} \oplus \boxed{\text{C}}
\end{array}\right] \right\rangle \\
\text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}), \left[\begin{array}{ll}
\textit{word} & \\
\text{SYN} & \boxed{3}\left[\begin{array}{ll}
\text{HEAD} & [\text{AGR} \quad [\text{NUM} \quad \text{pl}]] \\
\text{VAL} & \left[\begin{array}{ll} \text{SPR} & \boxed{\text{B}} \\ \text{COMPS} & \boxed{\text{C}} \end{array}\right]
\end{array}\right] \\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{\text{B}} \oplus \boxed{\text{C}}
\end{array}\right] \right\rangle
\end{array}\right]
$$

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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.

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Example: Lexical Entry for *cat*

$$\left\langle \text{cat} \;,\; \left[\begin{array}{l} \textit{cntn-lxm} \\ \text{SEM} \end{array}\right. \left[\begin{array}{ll} \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array}\right] \right\rangle \end{array}\right] \right\rangle$$

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Example: *cat*, with inheritance

$$\left\langle \text{cat} , \left[\begin{array}{l} \textit{cntn-lxm} \\ \text{SYN} \quad \left[\begin{array}{l} \text{VAL} \quad \left[\begin{array}{l} \\ \\ \end{array} \right] \\ \\ \end{array} \right] \\ \text{SEM} \quad \left[\begin{array}{l} \\ \text{INDEX} \quad k \\ \\ \text{RESTR} \quad \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array} \right] \right\rangle \end{array} \right] \\ \end{array} \right] \right\rangle$$

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Example: *cat*, with inheritance

$$\left\langle \text{cat}\ ,\ \begin{bmatrix} \textit{cntn-lxm} & \\ \text{SYN} & \begin{bmatrix} \text{VAL} & \begin{bmatrix} \text{SPR} & \left\langle \begin{bmatrix} \text{COUNT} & + \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & k \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{RELN} & \text{cat} \\ \text{INST} & k \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

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Example: *cat*, with inheritance

$$\left\langle \text{cat} \;,\; \left[\begin{array}{ll} \textit{cntn-lxm} & \\ \text{SYN} & \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{}\ [\ \text{PER} \quad \text{3rd}\ ] \end{array}\right] \\ \text{VAL} & \left[\begin{array}{ll} \text{SPR} & \left\langle \left[\begin{array}{ll} \text{DP} & \\ \text{COUNT} & + \end{array}\right] \right\rangle \\ & \boxed{} \end{array}\right] \end{array}\right] \\ \text{SEM} & \left[\begin{array}{ll} \text{MODE} & \text{ref} \\ \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array}\right] \right\rangle \end{array}\right] \\ \text{ARG-ST} & \langle \text{X} \rangle \end{array}\right] \right\rangle$$

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Example: *cat*, with inheritance

$$\left\langle \text{cat} , \left[\begin{array}{ll} \textit{cntn-lxm} & \\ \text{SYN} & \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{7}\,[\ \text{PER} \quad \text{3rd}\ ] \end{array}\right] \\ \text{VAL} & \left[\begin{array}{ll} \text{SPR} & \left\langle \left[\begin{array}{ll} & \text{DP} \\ \text{COUNT} & + \\ \text{AGR} & \boxed{7} \end{array}\right] \right\rangle \end{array}\right] \end{array}\right] \\ \text{SEM} & \left[\begin{array}{ll} \text{MODE} & \text{ref} \\ \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array}\right] \right\rangle \end{array}\right] \\ \text{ARG-ST} & \langle \text{X} \rangle \end{array}\right] \right\rangle$$

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Plural Noun LR

$$\left[\begin{array}{ll} \textit{i-rule} & \\ \text{INPUT} & \left\langle \boxed{1}\ ,\ \textit{cntn-lxm} \right\rangle \\ \text{OUTPUT} & \left\langle \text{F}_{NPL}(\boxed{1})\ ,\ \left[\begin{array}{ll} \textit{word} & \\ \text{SYN} & \left[\text{HEAD} \quad \left[\text{AGR} \quad \left[\text{NUM} \quad \text{pl}\right]\right]\right] \end{array}\right] \right\rangle \end{array}\right]$$

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Licensing *cats*

$$
\left[\begin{array}{l}
\textit{i-rule} \\
\\
\text{INPUT} \quad \left\langle \boxed{1}\text{cat} \;,\; \left[\begin{array}{ll}
\textit{cntn-lxm} & \\
\\
\text{SYN} & \boxed{3}\left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \boxed{7}[\ \text{PER} \quad \text{3rd}\ ] \end{array}\right] \\
\text{VAL} & \left[\text{SPR} \left\langle \left[\begin{array}{ll} \text{COUNT} & + \\ \text{AGR} & \boxed{7} \end{array}\right] \right\rangle \right]
\end{array}\right] \\
\text{SEM} & \boxed{2}\left[\begin{array}{ll} \text{MODE} & \text{ref} \\ \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array}\right] \right\rangle \end{array}\right] \\
\text{ARG-ST} & \boxed{B}\langle\ \text{X}\ \rangle \oplus \boxed{C}\langle\ \rangle
\end{array}\right] \right\rangle \\
\\
\text{OUTPUT} \quad \left\langle \text{F}_{NPL}(\boxed{1}) \;,\; \left[\begin{array}{ll}
\textit{word} & \\
\\
\text{SYN} & \boxed{3}\left[\begin{array}{ll} \text{HEAD} & [\text{AGR} \quad [\text{NUM} \quad \text{pl}]] \\ \text{VAL} & \left[\begin{array}{ll} \text{SPR} & \boxed{B} \\ \text{COMPS} & \boxed{C} \end{array}\right] \end{array}\right] \\
\text{SEM} & \boxed{2} \\
\text{ARG-ST} & \boxed{B} \oplus \boxed{C}
\end{array}\right] \right\rangle
\end{array}\right]
$$

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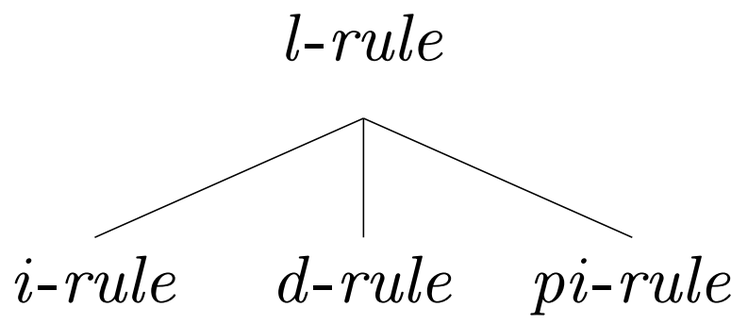
Three Subtypes of *l-rule*



$$\textit{l-rule}: \begin{bmatrix} \text{INPUT} & \textit{l-sequence}\left\langle \text{X} , [\ \text{SEM} \quad / \boxed{2}\ ] \right\rangle \\ \text{OUTPUT} & \textit{l-sequence}\left\langle \text{Y} , [\ \text{SEM} \quad / \boxed{2}\ ] \right\rangle \end{bmatrix}$$

$$\textit{i-rule}: \begin{bmatrix} \text{INPUT} & \left\langle \text{X} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad \boxed{3} \\ \text{ARG-ST} \quad \boxed{\text{A}} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y} , \begin{bmatrix} \textit{word} \\ \text{SYN} \quad \boxed{3} \\ \text{ARG-ST} \quad \boxed{\text{A}} \end{bmatrix} \right\rangle \end{bmatrix}$$

$$\textit{d-rule}: \begin{bmatrix} \text{INPUT} & \left\langle \text{X} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad / \boxed{3} \end{bmatrix} \right\rangle \\ \text{OUTPUT} & \left\langle \text{Y} , \begin{bmatrix} \textit{lexeme} \\ \text{SYN} \quad / \boxed{3} \end{bmatrix} \right\rangle \end{bmatrix}$$

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cats: The Lexical Sequence

$$\left\langle \text{cats} , \left[\begin{array}{ll} \textit{word} & \\ \text{SYN} & \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{ll} \textit{noun} & \\ \text{AGR} & \textit{3pl} \end{array}\right] \\ \text{VAL} & \left[\begin{array}{ll} \text{SPR} & \boxed{\text{B}}\left\langle \left[\begin{array}{ll} \text{COUNT} & + \\ \text{AGR} & \boxed{7} \end{array}\right] \right\rangle \\ \text{COMPS} & \langle\,\rangle \end{array}\right] \end{array}\right] \\ \text{SEM} & \left[\begin{array}{ll} \text{MODE} & \text{ref} \\ \text{INDEX} & k \\ \text{RESTR} & \left\langle \left[\begin{array}{ll} \text{RELN} & \text{cat} \\ \text{INST} & k \end{array}\right] \right\rangle \end{array}\right] \\ \text{ARG-ST} & \boxed{\text{B}} \end{array}\right] \right\rangle$$

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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

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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?

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Constant Lexeme LR

$$\left[\begin{array}{ll} \textit{i-rule} & \\ \text{INPUT} & \langle\ \boxed{1}\ ,\ \textit{const-lxm}\ \rangle \\ \text{OUTPUT} & \left[\text{FIRST}\quad \boxed{1}\right] \end{array}\right]$$

- What keeps this from applying to, say, verb lexemes?
- Why is this an *i-rule*?

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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*?

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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.

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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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Overview

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- Three types of lexical rules, constraints
- Example: Plural noun lexical rule
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- The feature FORM

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