Modeling the generative capacity

(1) Shifting gears a bit: (we'll finish last time's handout shortly)
   - Goal for the last couple of weeks: parsing and generating known forms
     - What does meowing mean? What is the past tense of walk?
     - We have been assuming that we have access to a lexicon with the words meow, walk, etc., and they are known to be regular
     - How does the model know that they are regular?
     - Why is this probably not a very realistic model of human speakers?
   - Goal for the rest of the course: modeling speakers rather than languages

(2) What do speakers know about generating forms?
   - What is the past tense of walk? sing? anastomose? mip? spling?
   - Two (potentially) distinct tasks:
     - Producing forms of known verbs
     - Producing forms of nonce verbs (heard for the first time)

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<tr>
<th>Verb</th>
<th>Reg. past</th>
<th>Reg. responses</th>
<th>Irreg. past</th>
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   - What do you need to know to do these tasks? What influences responses for a particular verb? What do you need to learn?

(3) Two different models of the generative capacity:
   - Grammar of rules (suffix -ed, change [i] to [æ], etc.)
   - Analogy to existing forms (form past like walked, form past like sang, etc.)

(4) We’ll look at models of both types this week

A rule-based model

➢ Introduction to the approach on last time's handout
(5) Summary so far: constructing rules by comparing forms
   - Successively comparing forms eventually yields very general rules
     
   \[
   \begin{align*}
   \text{shine: } & \emptyset \rightarrow d / \left[ \text{ain } \_ \_ \_ \right]^{\text{[past]}} \\
   \text{rub: } & \emptyset \rightarrow d / \left[ \text{rab } \_ \_ \_ \right]^{\text{[past]}} \\
   \text{dry: } & \emptyset \rightarrow d / \left[ \text{drai } \_ \_ \_ \right]^{\text{[past]}} \\
   \text{sing: } & \emptyset \rightarrow d / \left[ \text{s} \_ \_ \_ \right]^{\text{[past]}}
   \end{align*}
   \]

(6) And likewise for other changes

\[
\begin{align*}
\text{drink: } & \emptyset \rightarrow d / \left[ \text{dr } \_ \_ \right]^{\text{[past]}} \\
\text{shrink: } & \emptyset \rightarrow d / \left[ \text{Sr } \_ \_ \_ \right]^{\text{[past]}} \\
\text{sing: } & \emptyset \rightarrow d / \left[ \text{s } \_ \_ \_ \right]^{\text{[past]}}
\end{align*}
\]

(7) Competition between different patterns: novel verb spling [splŋ]
   - The rule \( \emptyset \rightarrow d / [+\text{voi}] \_ \_ \_ \_ \) predicts splinged [splŋd]
   - The rule \( 1 \rightarrow \text{æ} / X \left[ -\text{syl} +\text{cor} \right] Y \) predicts splang [splæŋ]

(8) Similar rules for other changes (1 \( \rightarrow \), \( \lambda \), etc.)

(9) Rule evaluation: how do we know which rules to trust?
   - Intuition: we want to trust the rules that actually work!
   - Working means that they derive correct outputs for many verbs, and derive as few incorrect outputs as possible
   - The rule \( \emptyset \rightarrow d / [+\text{voi}] \_ \_ \_ \_ \) works for tons of verbs (all regular verbs ending in voiced segments), but it fails for some verbs (such as sing, for which it predicted *singed)
   - The rule \( 1 \rightarrow \text{æ} / X \left[ -\text{syl} +\text{cor} \right] Y \) works for a handful of verbs (drink, shrink, sing, ring, etc.)
     but it fails for a lot of verbs (such as sink, bring, sync, etc.)

(10) Calculating rule performance: two useful numbers
   - \textit{Scope}: equals the number of words that the rule could potentially apply to (that is, the words that meet the structural description of the rule)
   - \textit{Hits}: equals the number of forms that the rules can successfully derive
   - \textit{Reliability} of the rule = \frac{\text{hits}}{\text{scope}}

(11) Example: the rule \( 1 \rightarrow \text{æ} / X \left[ -\text{syl} +\text{cor} \right] Y \)
   - Can successfully derive 6 hits (drink, shrink, spring, ring, sing, sink)
   - Fails for 11 others (at least): bring, spring (~ sprung), slink, spling, fling, link, string, wrinkle, sprinkle, crinkle, linger
   - \text{Scope} = 6 + 11 = 17
   - \text{Reliability} of the rule = \frac{6}{17} = 0.35