Synergies in learning words and their referents

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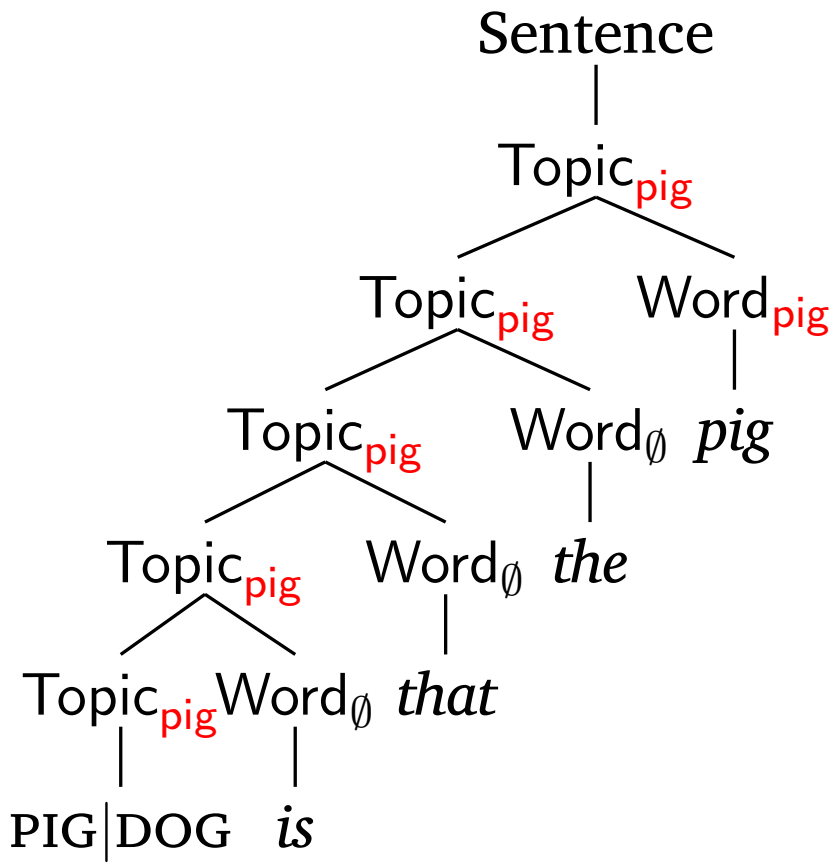
- Input: unsegmented utterances tagged with contextual objects
- Output: word segmentation and word to object mapping

PIG|DOG ▲ ɪ △ z ▲ ð △ æ △ t ▲ ð △ ə ▲ p △ ɪ △ g ▲

PIG

Word to object "topic models" as PCFGs

- Objects in non-linguistic context $\approx$ sentence topics
- Such topic models can be expressed as *Probabilistic Context-Free Grammars*
- PCFG rules *choose a topic* from possible topic marker and *propagate it through sentence*
- Each word is either generated by sentence topic or a special null topic



- Requiring *at most one topic per sentence*:
  - improves accuracy
  - can be expressed by PCFG

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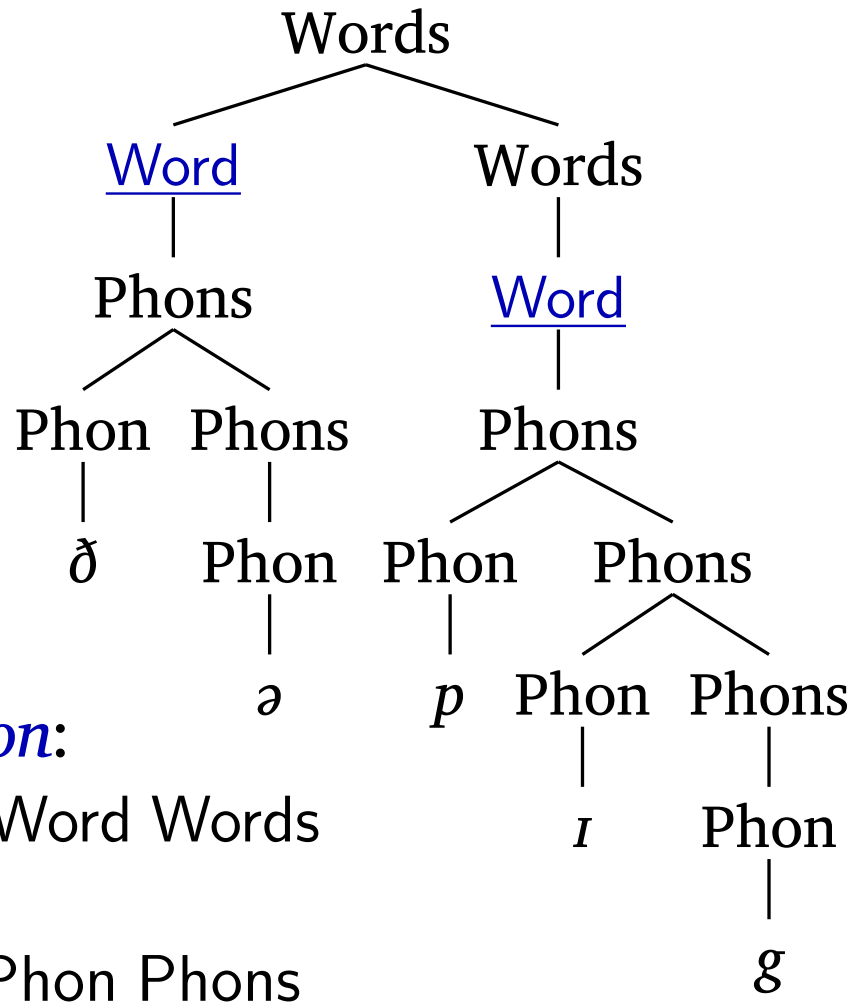
Adaptor grammars for word segmentation

- Adaptor grammars (AGs) generalise PCFGs by learning probability of *entire subtrees*
  - Prob. of adapted subtree $\propto$ *number of times tree was previously generated* $+ \alpha \times$ PCFG prob. of subtree
  - AGs are *hierarchical Dirichlet or Pitman-Yor Processes*



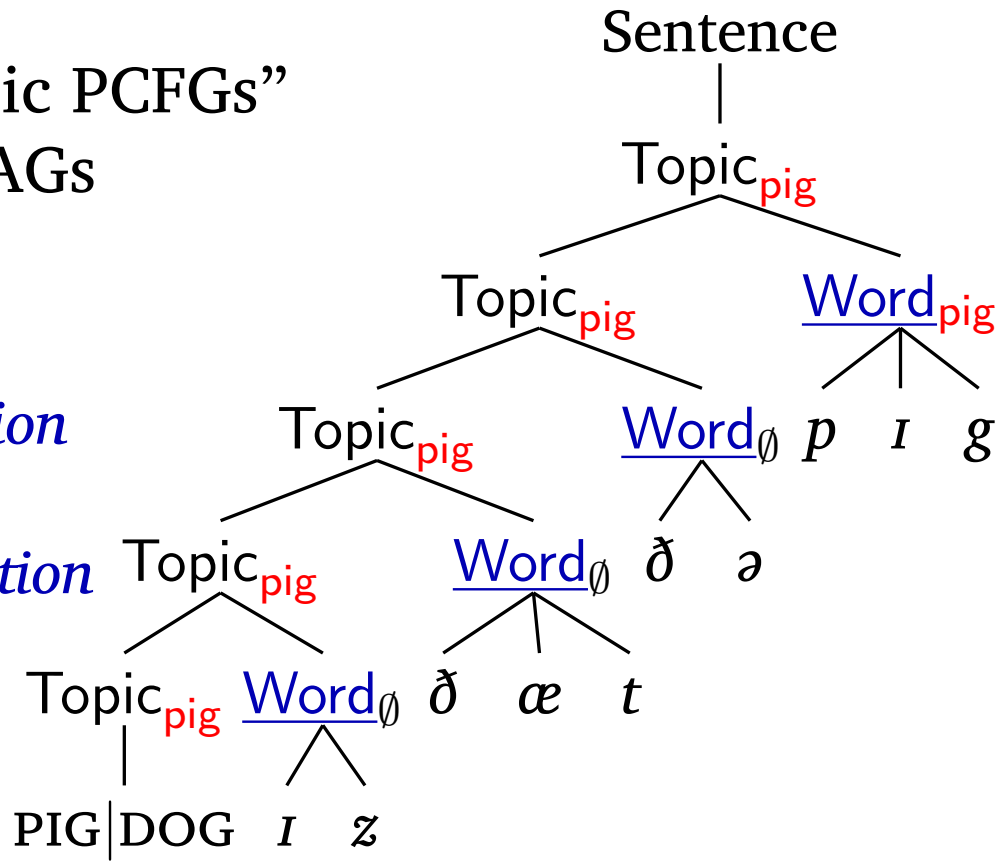
- AG for *unigram word segmentation*:

$$\text{Words} \rightarrow \text{Word} \mid \text{Word Words}$$
$$\underline{\text{Word}} \rightarrow \text{Phons}$$
$$\text{Phons} \rightarrow \text{Phon} \mid \text{Phon Phons}$$

- Segmentation accuracy improves if AG *learns collocations*

Joint segmentation and object-mapping

- Combine word-object "topic PCFGs" with word segmentation AGs
- Synergies in learning:
  - *improving topic detection improves word segmentation* 70% ↦ 75% f-score
  - *improving word segmentation improves topic detection* 50% ↦ 74% f-score



- Joint (rather than staged) learners can exploit these synergies
- Are there similiar synergies in other aspects of language acquisition?
- Do human learners exploit such synergies?

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