Modelling vocabulary acquisition in spoken word recognition

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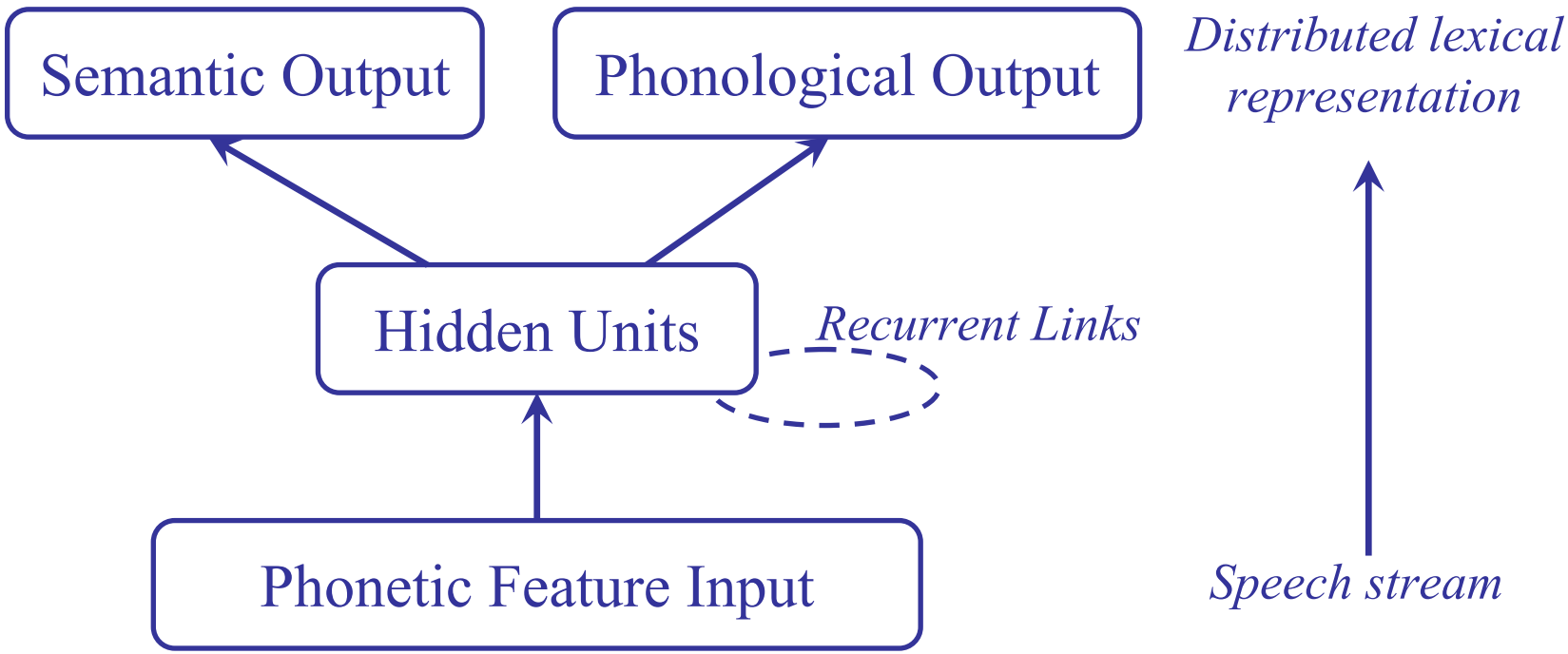
Models of human spoken word recognition

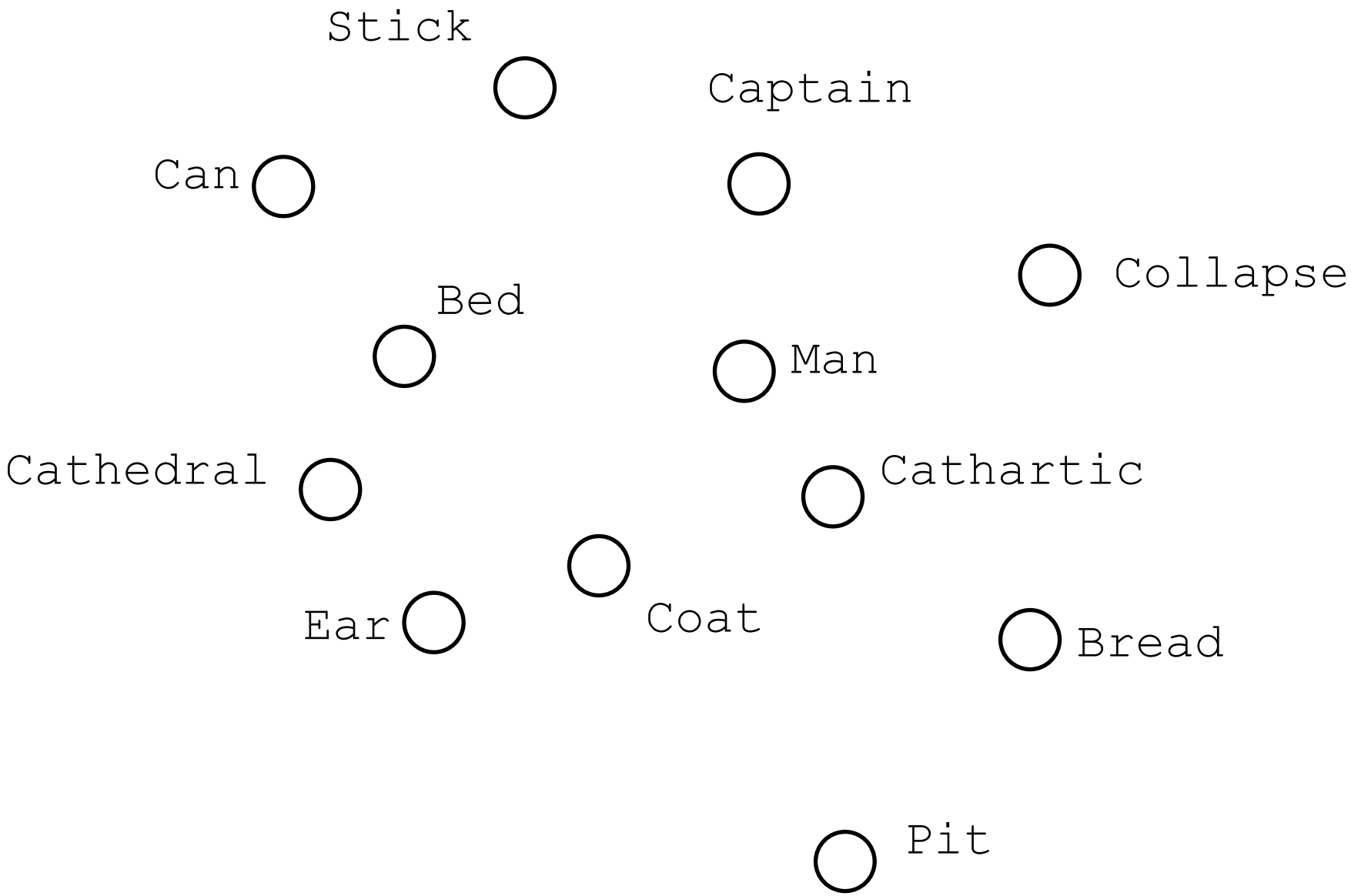
- Box & Arrow - Cohort; Marslen-Wilson & Welsh, 1979)
- IAC – TRACE (McClelland & Elman, 1986), Shortlist (Norris, 1993)
- ASR-hybrid (Scharenborg et al., 2003)
- ART – (Vitevitch & Luce., 1999)
- Backpropagation – DCM (Gaskell & Marslen-Wilson, 1997)
- In these models many aspects of word learning are either impossible or severely downplayed

DCM (Gaskell & Marslen-Wilson, 1997)



Vocabulary acquisition and the lexicon

- Current models of word recognition do not address changes in organisation of the system
  - developmental changes
  - changes in adult processing (e.g., phonemic, lexical)
- Example:
  - acquisition of novel words and their impact on lexical organisation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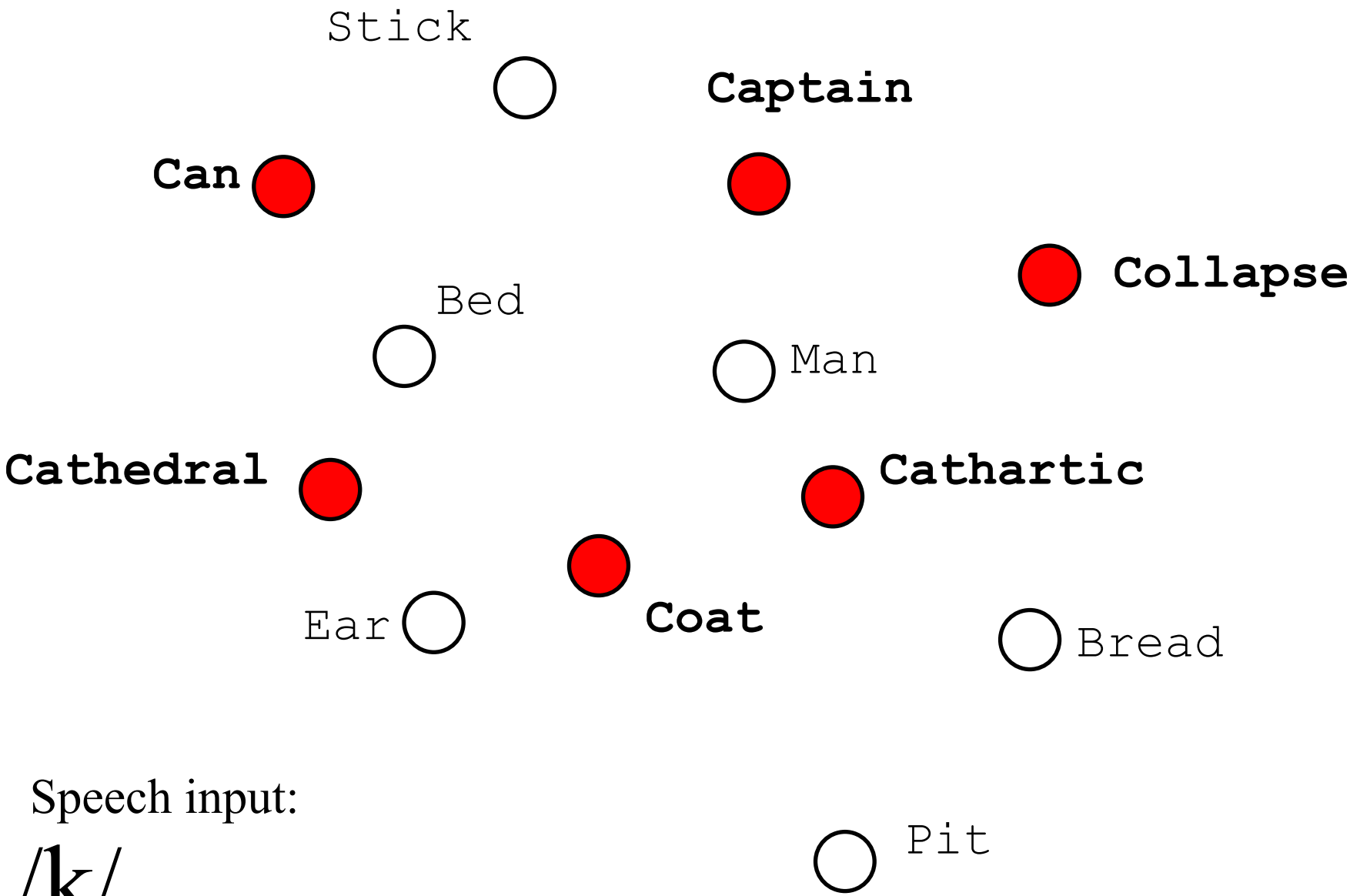

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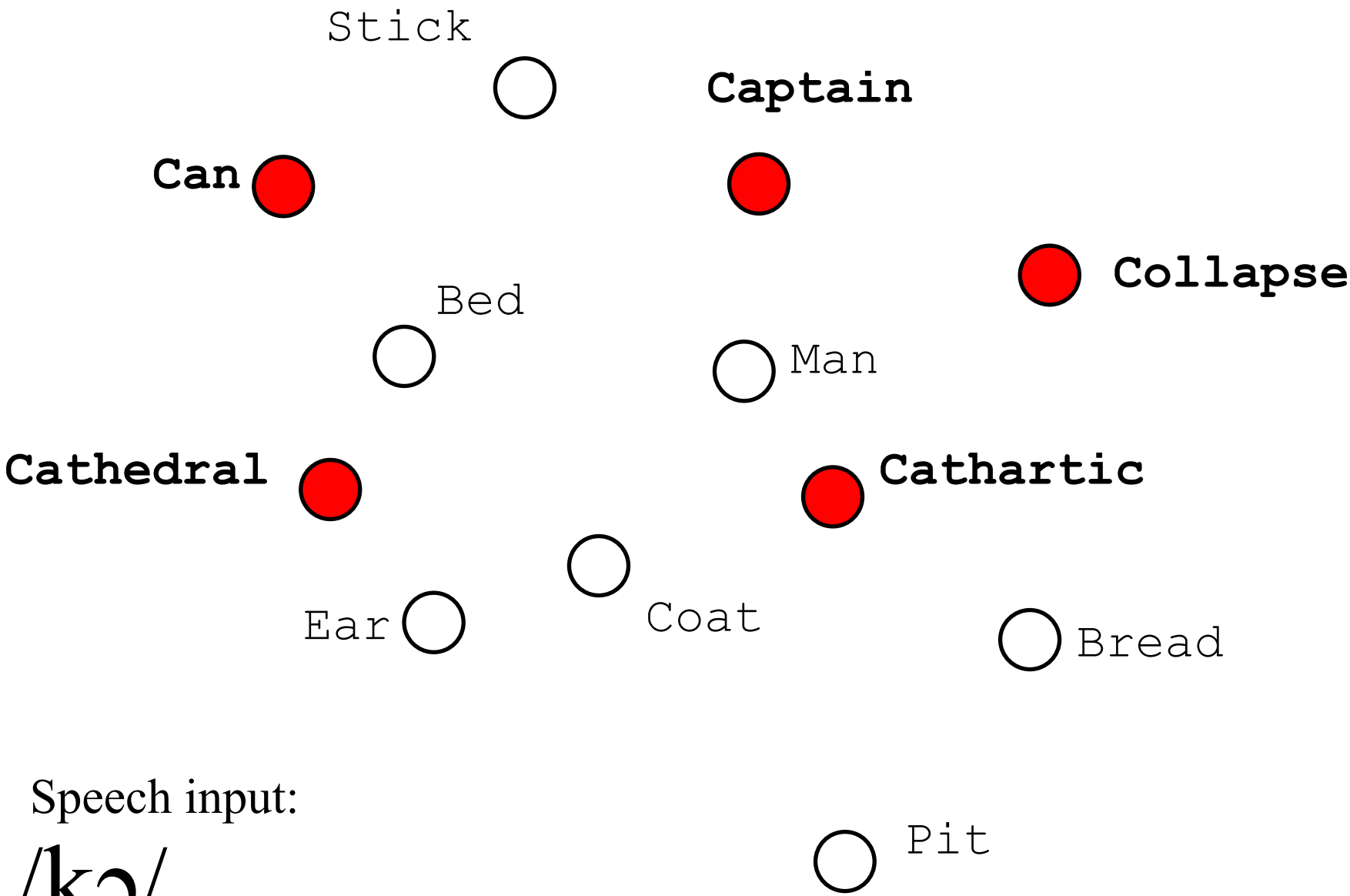

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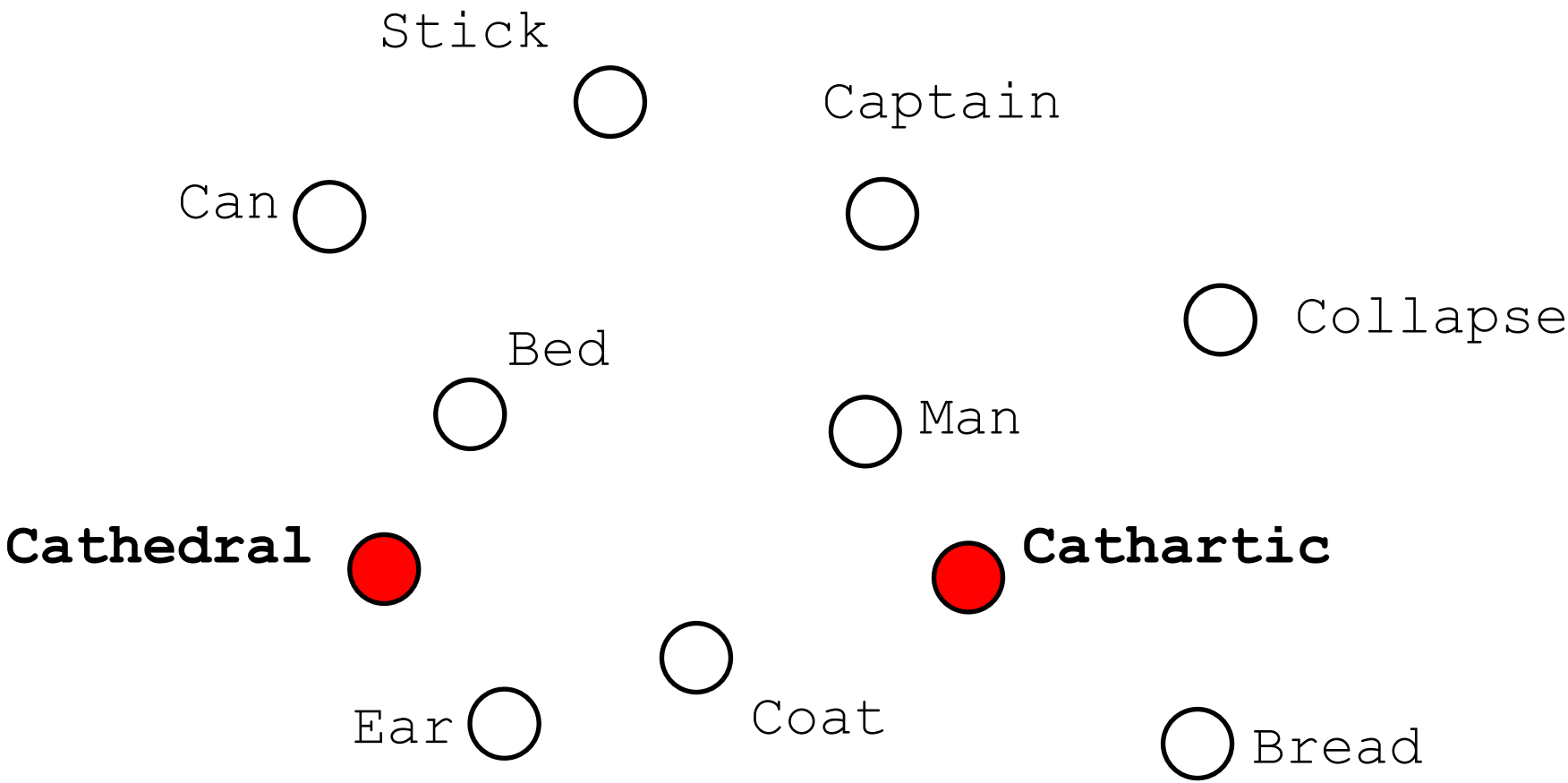

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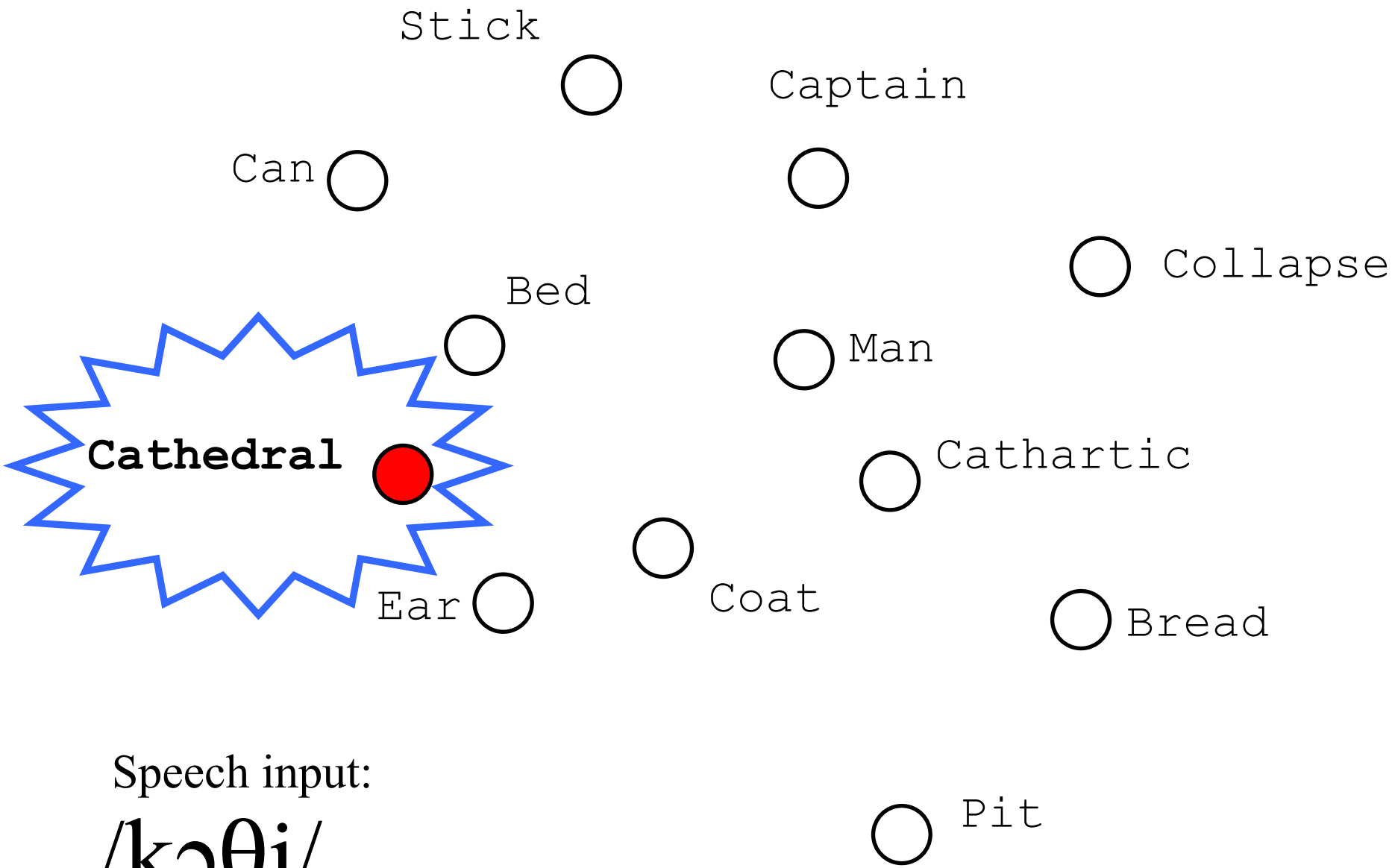

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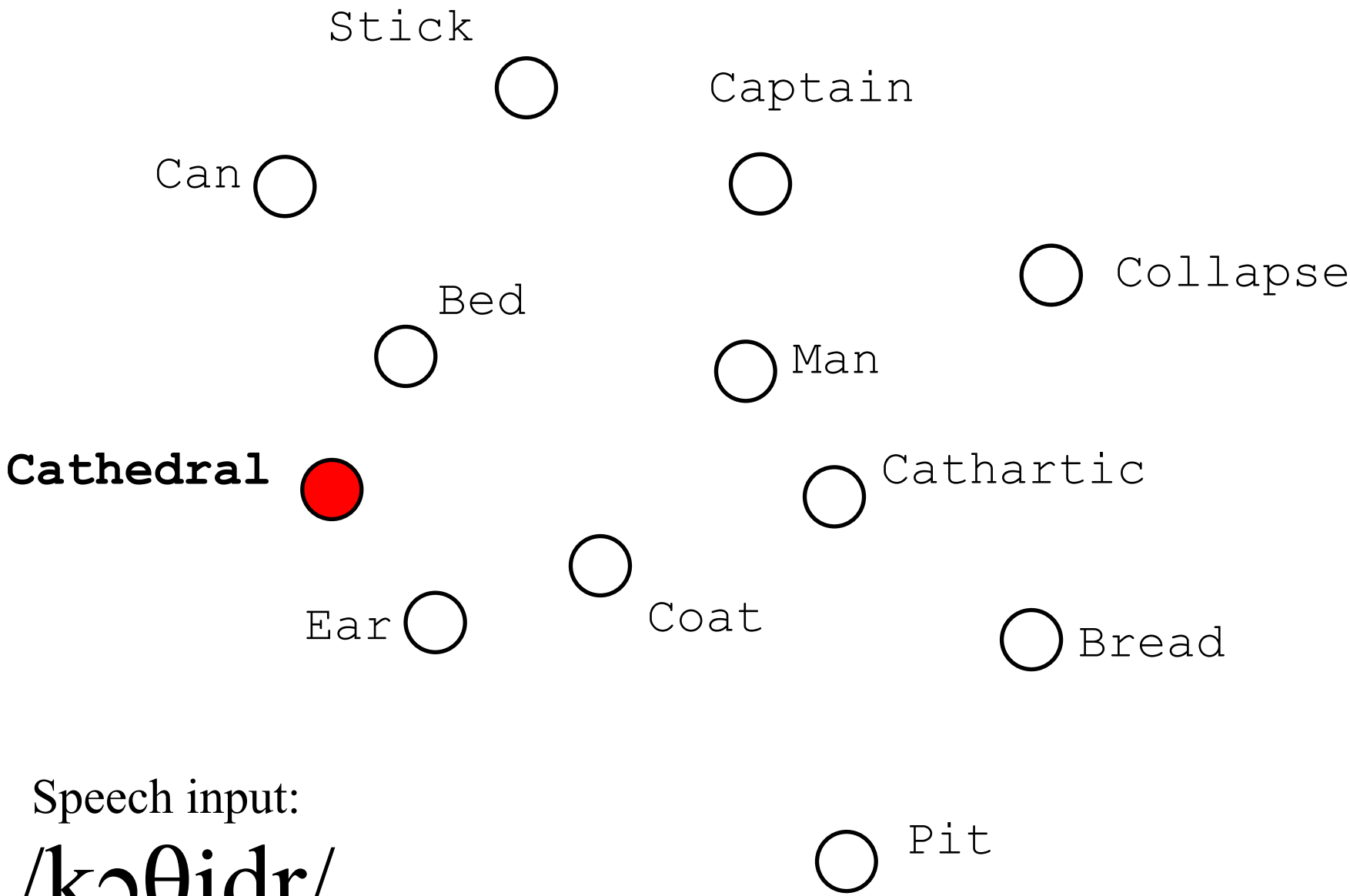

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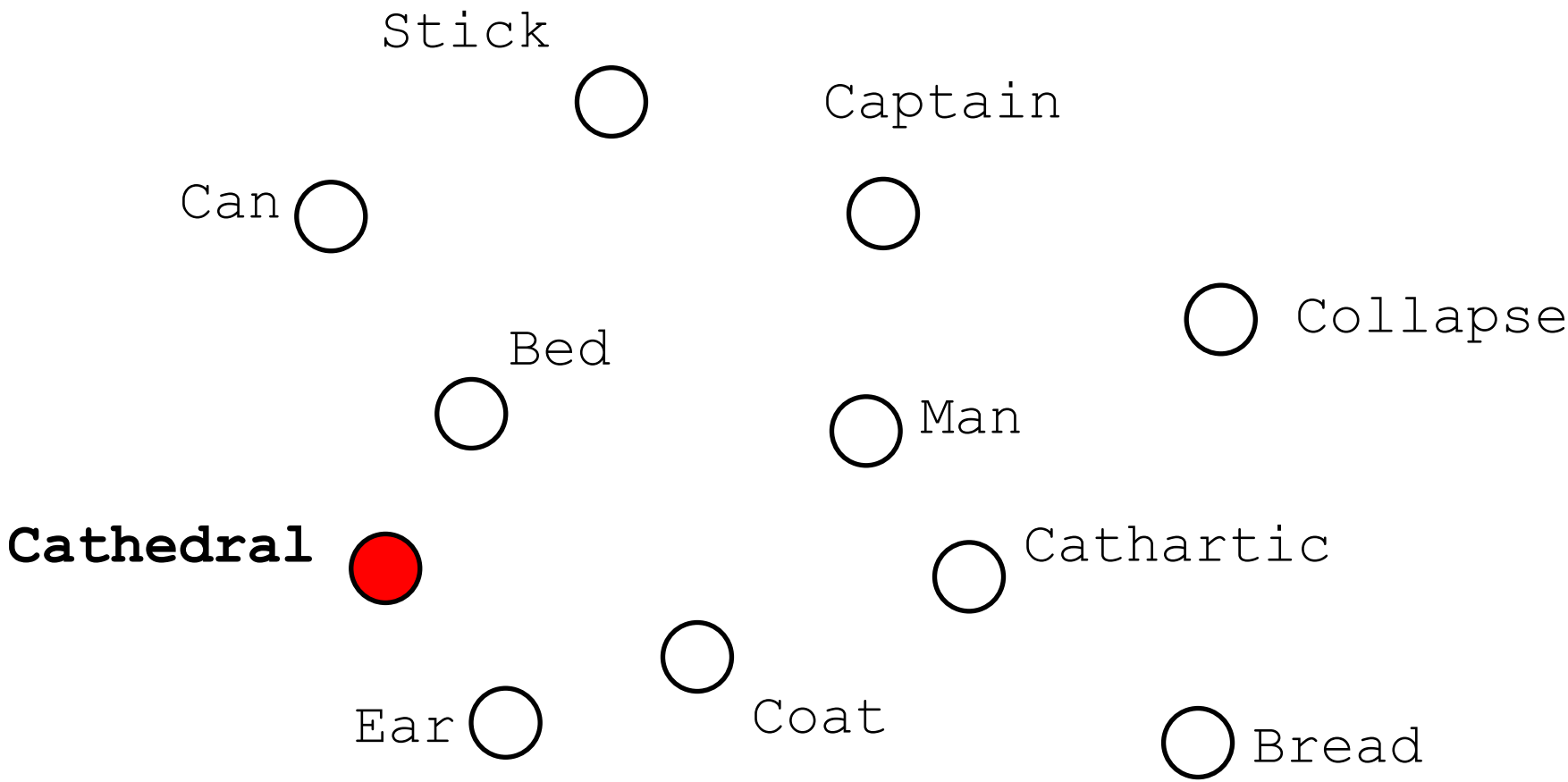

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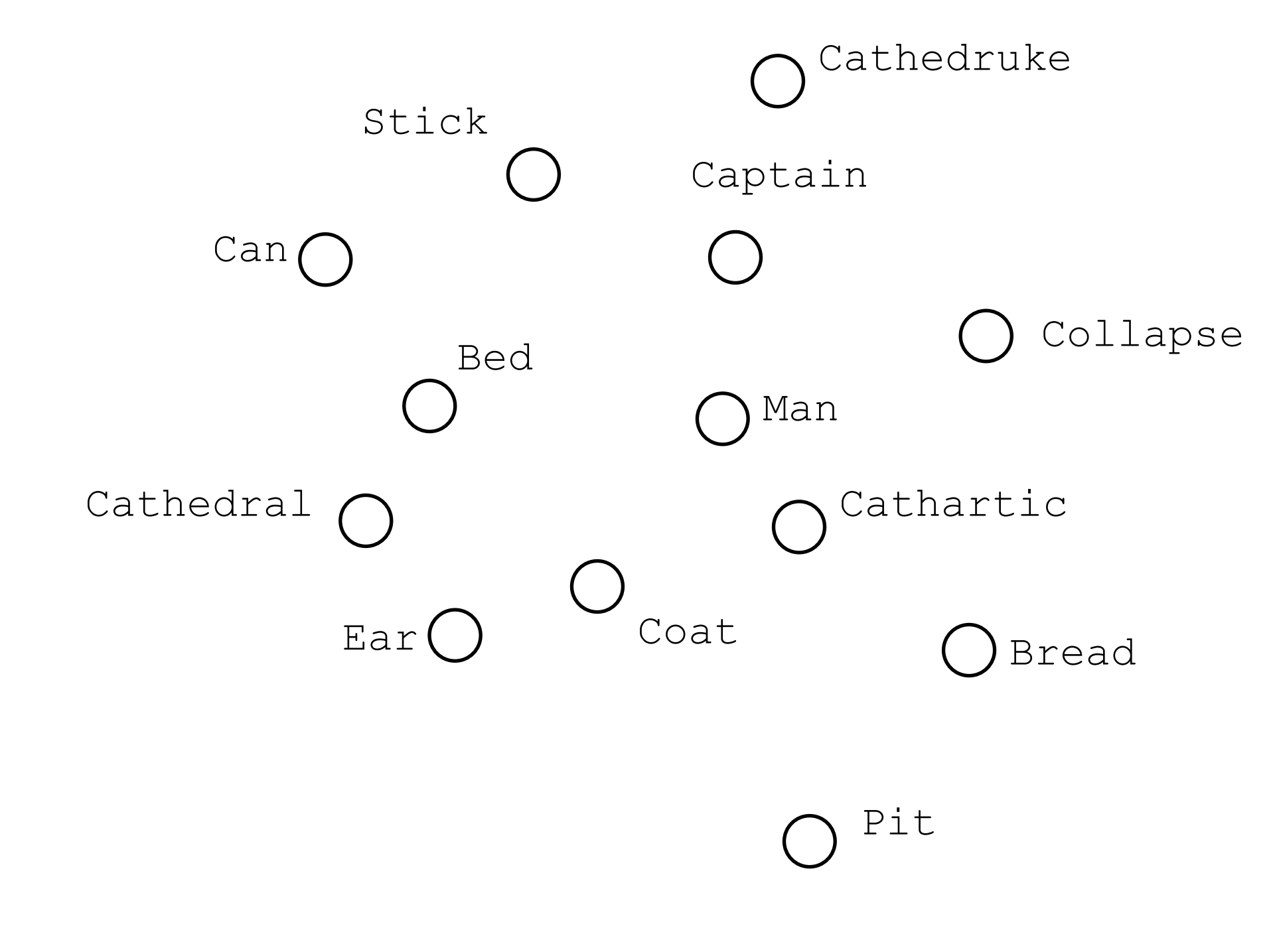
Novel word learning

- What if we teach people a novel spoken word: “cathedruke”?
- This should enter the competition process and *slow down* recognition of existing words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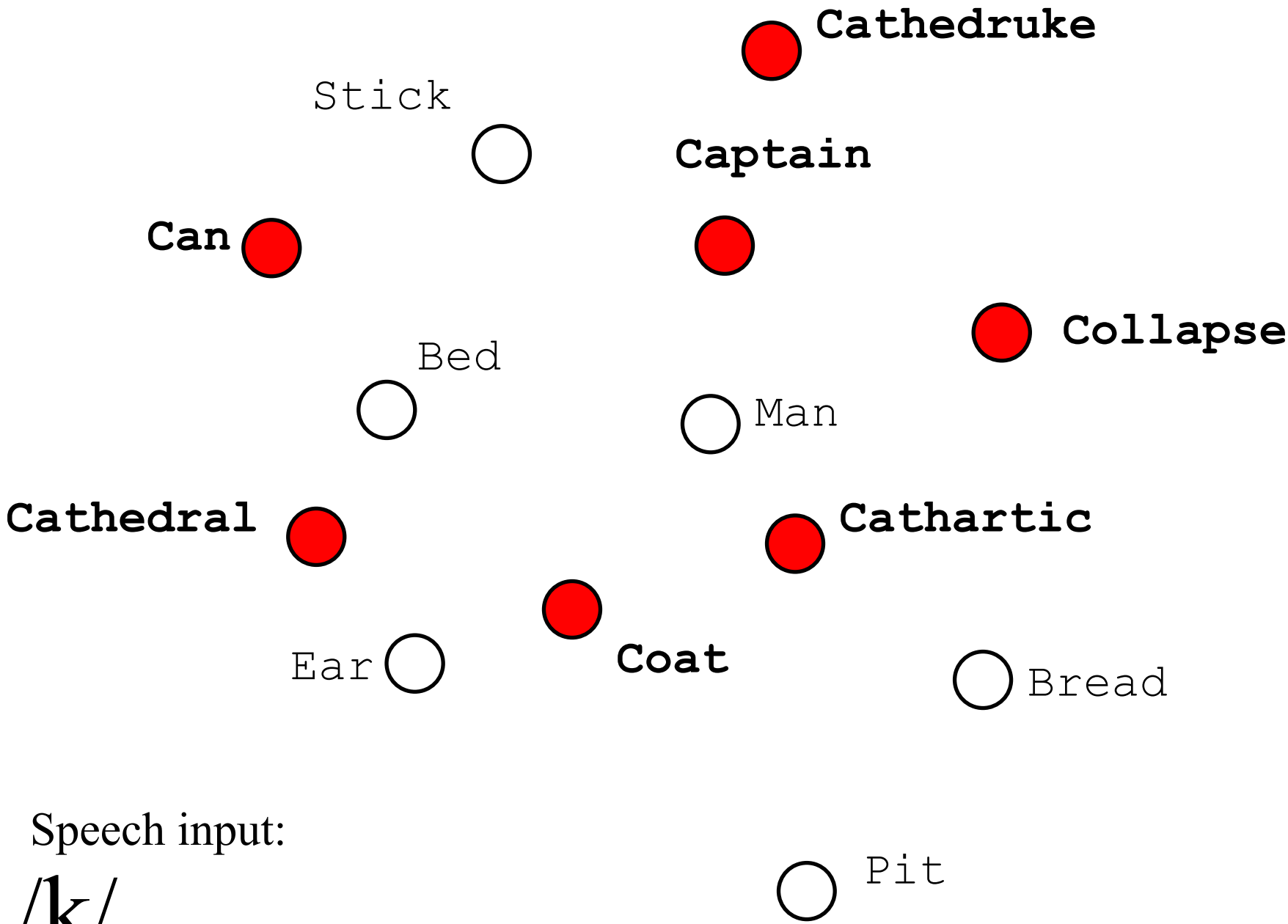

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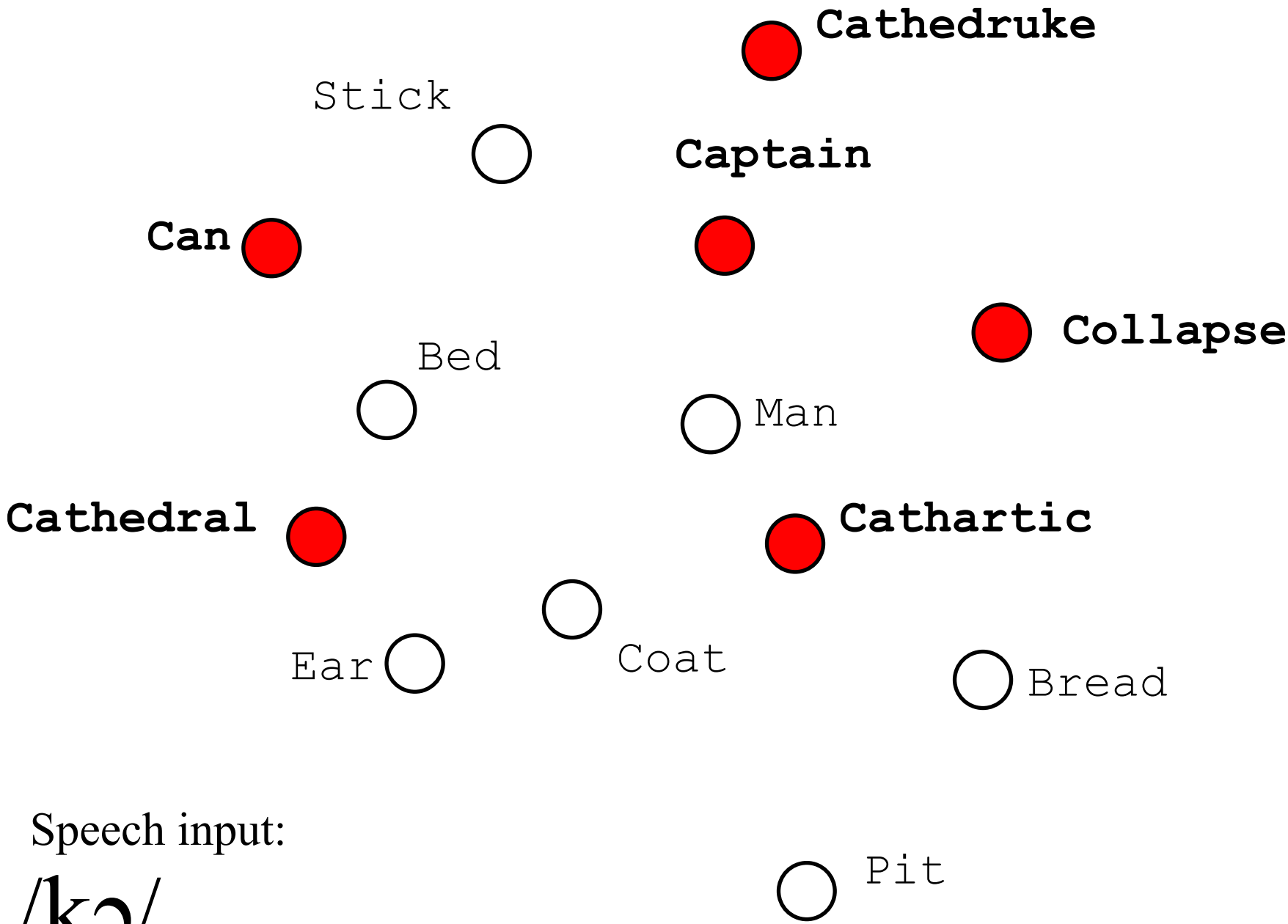

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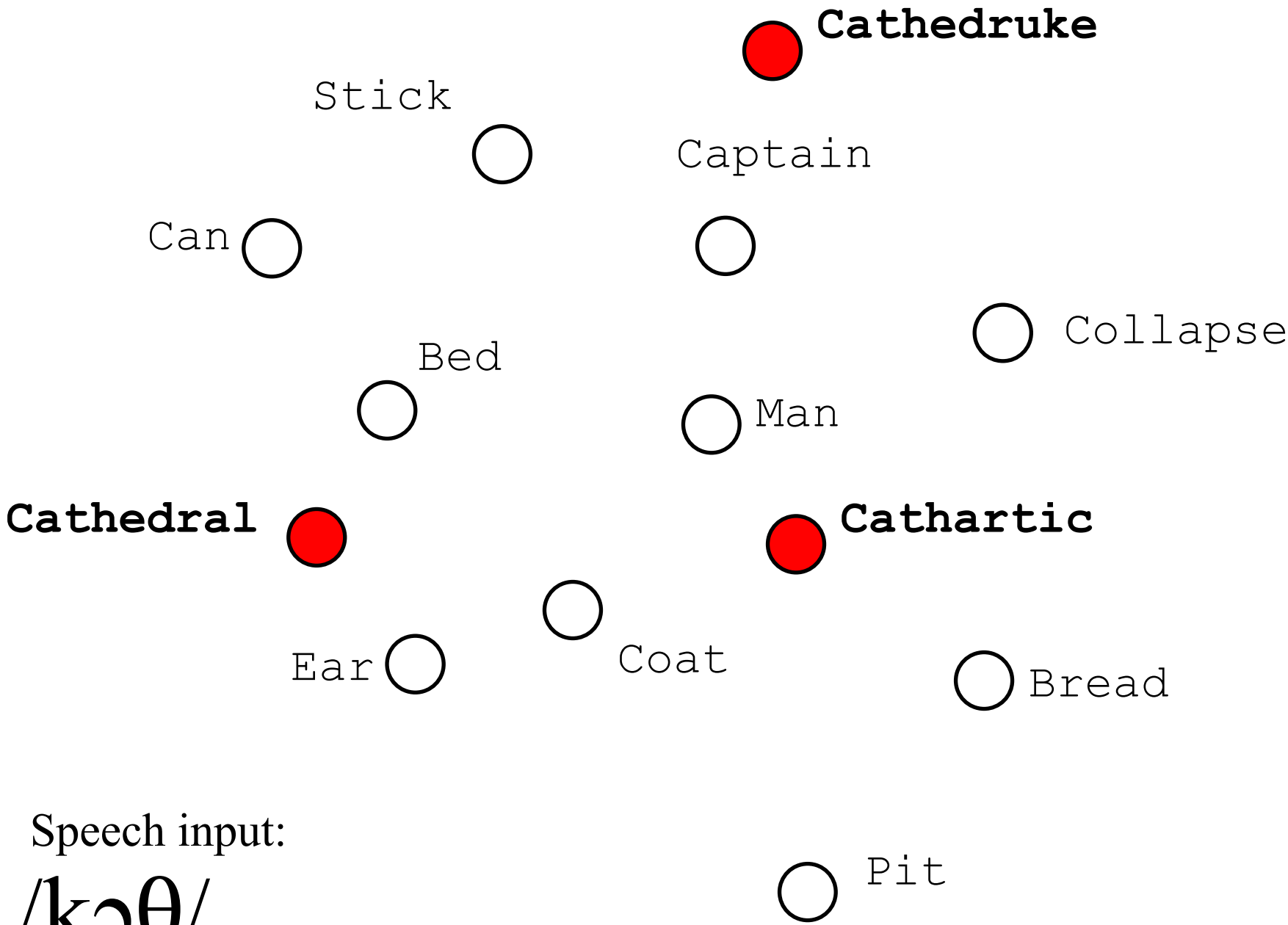

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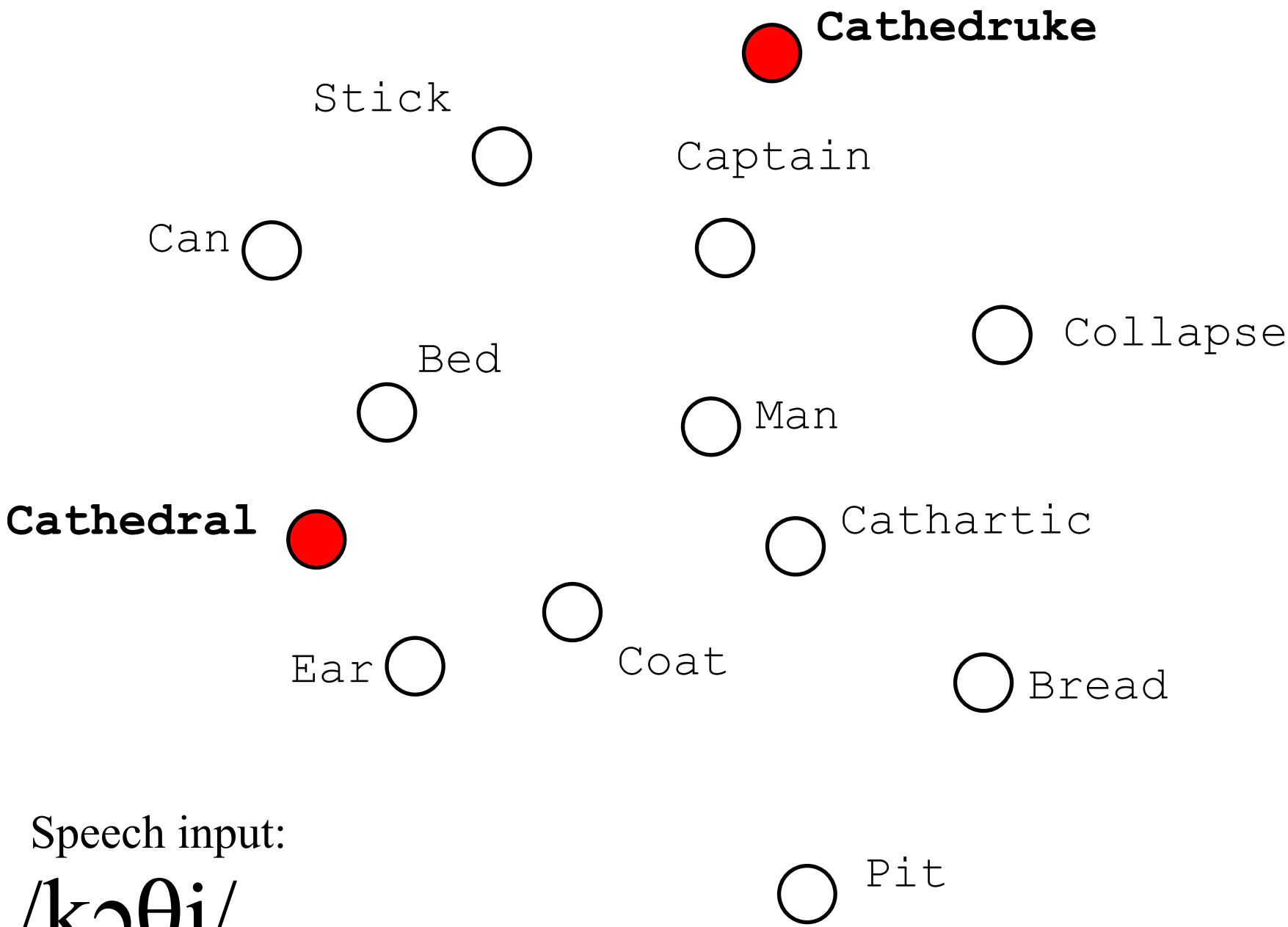

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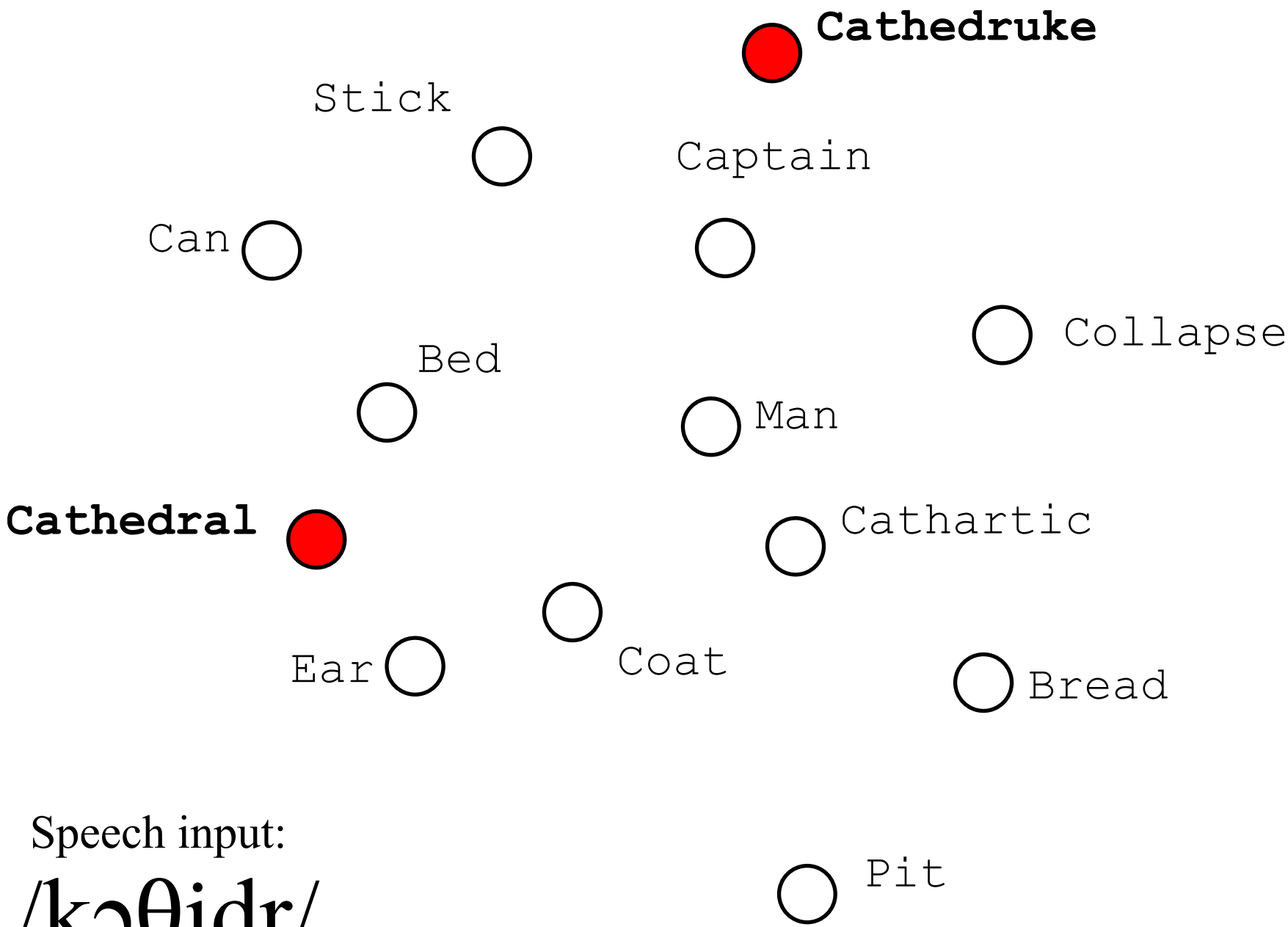

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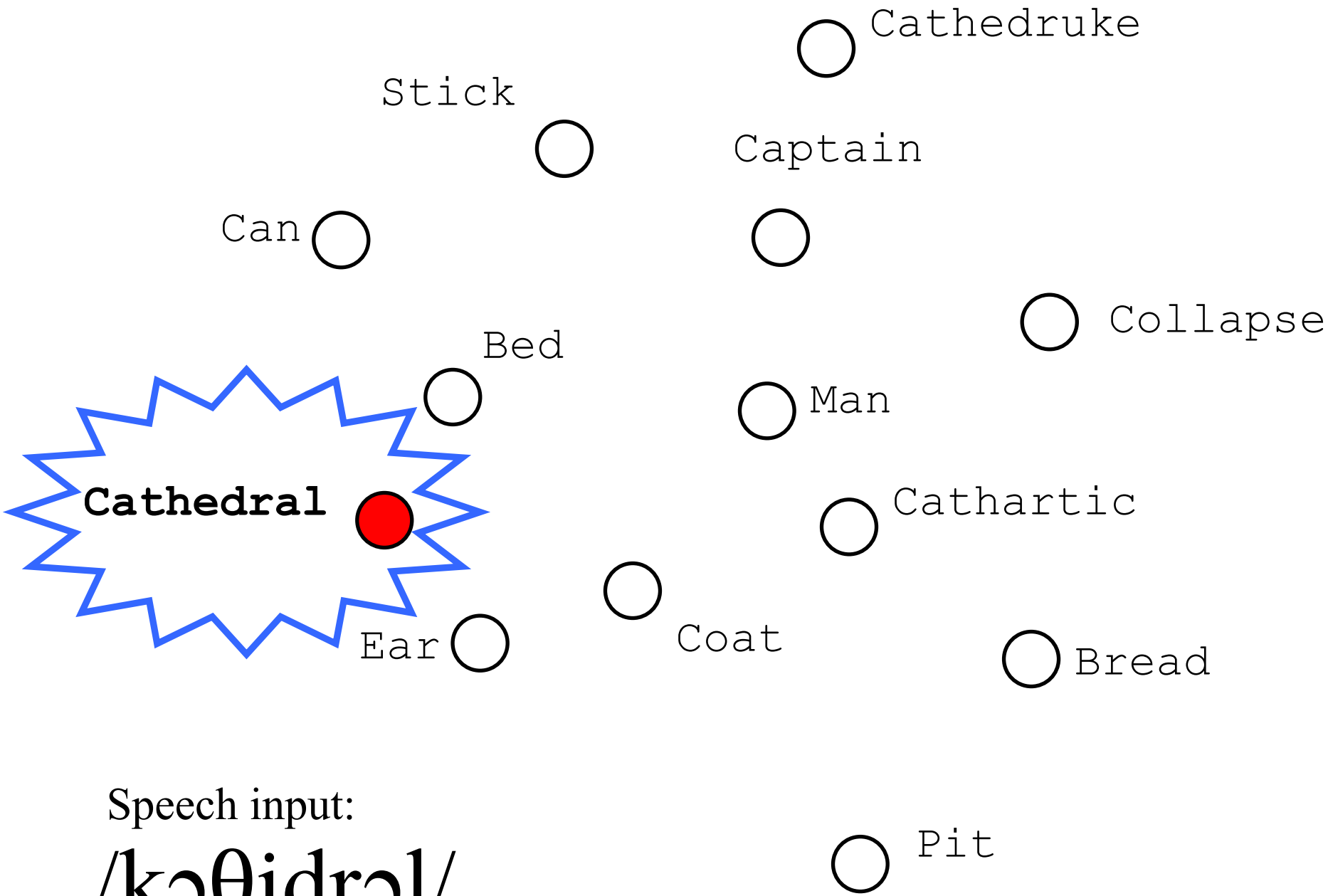

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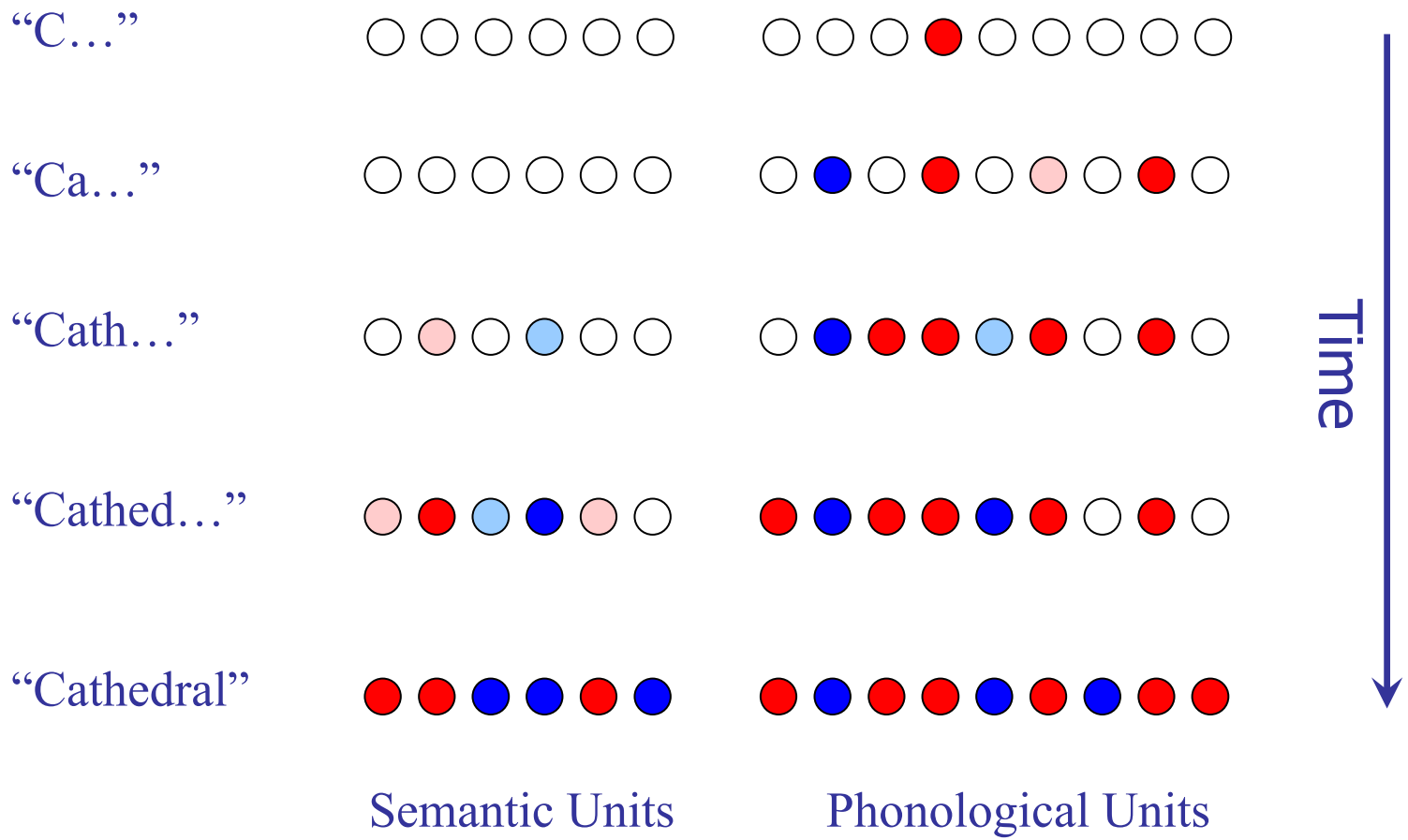
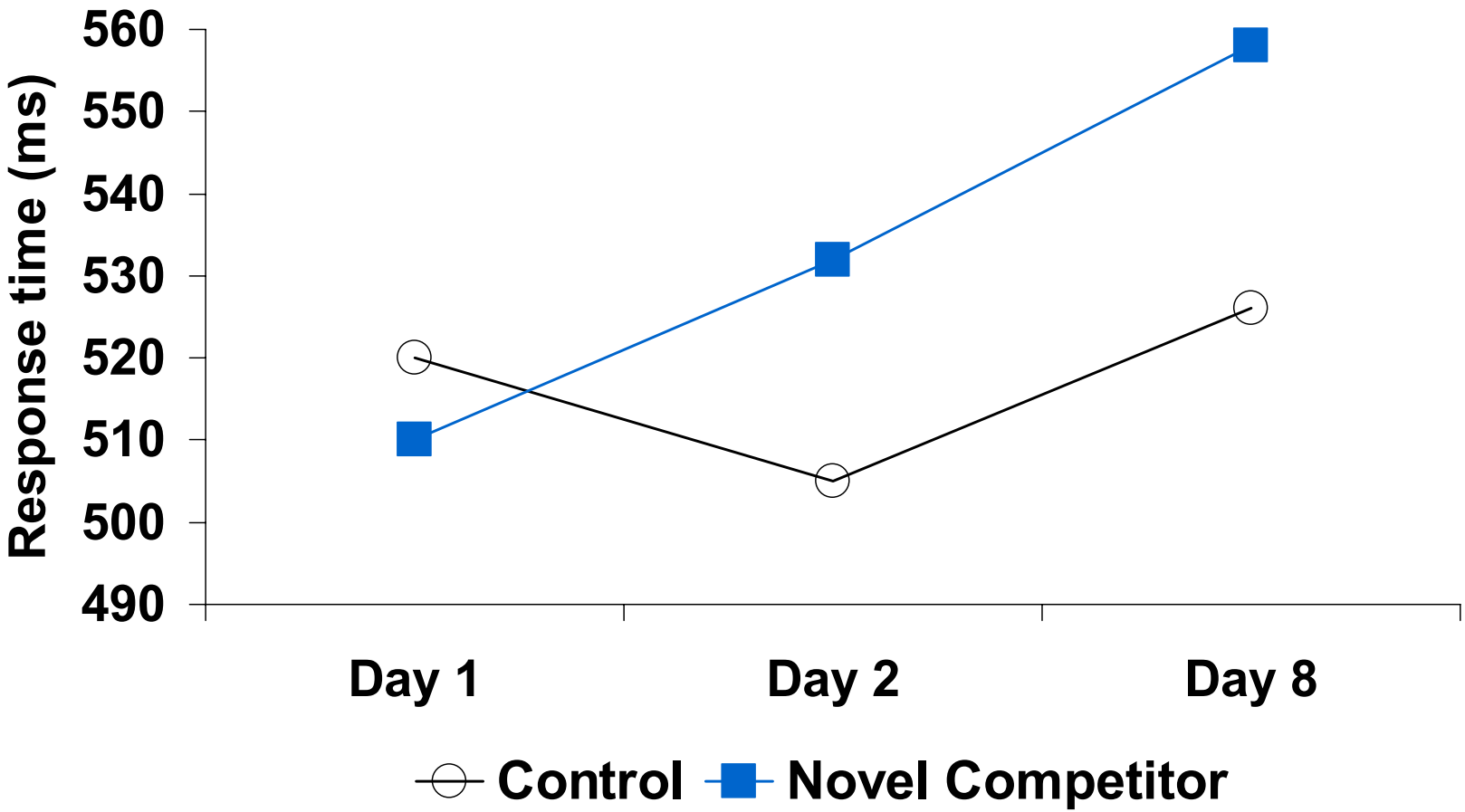
Lexical access as filling in the features



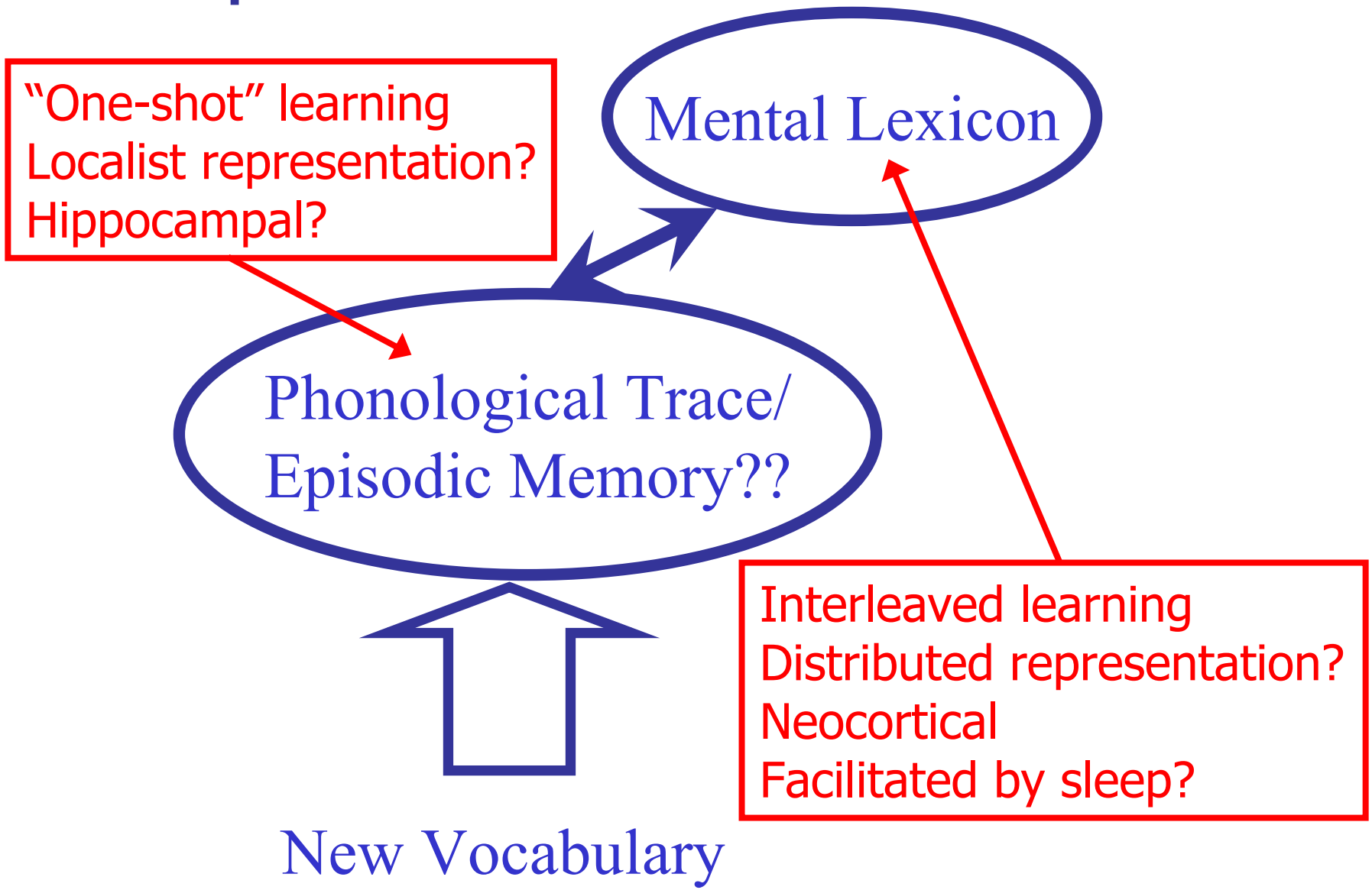
Novel word learning (Gaskell & Dumay, 2003; Dumay, Gaskell & Feng, 2004)

- Teach people novel spoken word: "cathedruke"
- Immediate effect on explicit memory
  - people can recognise "cathedruke" easily
- Delayed effect on lexical processing
  - after 24 hours people are slower to recognise cathedral
  - latest data suggest consolidation during sleep is the key

Delayed lexical competition



Dual-speed lexicalisation



Project proposal

- Computationally & neurally explicit model of acquisition and storage of spoken words
  - Behavioural research
    - more on time course and informational circumstances underlying lexicalisation and other aspects of learning
  - Neuroimaging
    - Investigate neural bases of immediate and delayed aspects of word learning
  - Computational modelling
    - connectionist and statistical modelling of above

Behavioural research

- More on:
  - Role of time in lexicalisation
  - Role of sleep in lexicalisation
  - Is there a lower limit on degree of exposure to novel items?
  - Stability of lexical representations
- Increase synergies with developmental research

Neuroimaging

- fMRI research
  - neural correlates of one-shot learning and lexicalisation
  - involvement of sleep
  - cross-referencing with other types of memory consolidation during sleep
- MEG research
  - track timecourse and localisation of lexical competition for novel items using magnetic MMN (Pulvermüller et al., 2003)

Computational Modelling

- Starting point: DCM (Gaskell & Marslen-Wilson, 1997)
  - biologically plausible
  - implement dual-speed learning systems
  - integrate with more sophisticated front end
  - integrate with other aspects of plasticity (e.g., age of acquisition, segmental adaptation)

Scope of model

- Address three bodies of research; so far as possible relating behavioural and neuroimaging data
  - "steady-state" data on lexical access/lexical competition in speech perception
  - plasticity, vocabulary learning, lexicalisation
  - developmental language data