

Chapter 17. Speech Recognition and Understanding Systems

The Quest for Artificial Intelligence, Nilsson, N. J., 2009.

Lecture Notes on Artificial Intelligence

Summarized by Jang, Ha-Young and Lee, Chung-Yeon

Biointelligence Laboratory
School of Computer Science and Engineering
Seoul National University

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Subsequent Work in Speech Recognition

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Overview of Chapter 17

- Speech processing is divided between speech recognition and speech understanding
- The speech understanding study group
 - Work at BBN
 - Work at CMU
 - Supported by DARPA research program
- Subsequent work in speech recognition

Chapter 17. Speech Recognition and Understanding Systems

17.1 Speech Processing

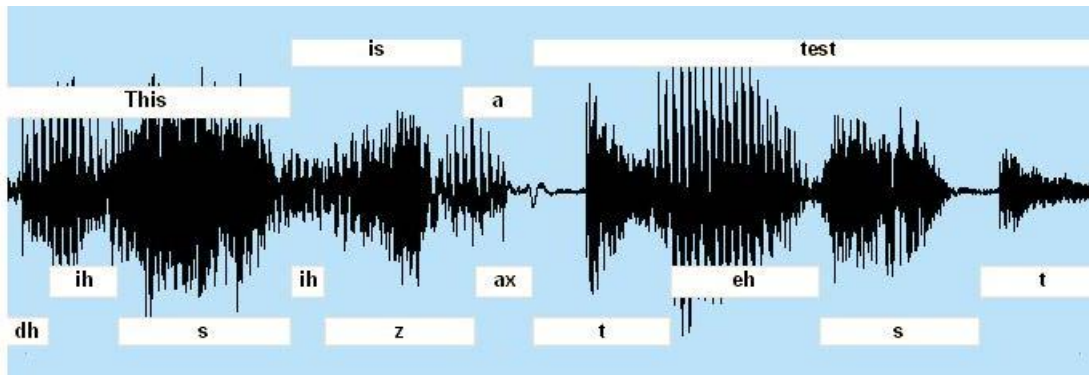
Speech Preprocessing

■ Speech recognition

- Process of converting an acoustic stream of speech input into a text representation of its component.

■ Speech understanding

- Understanding what is spoken.



A speech waveform

Symbol Example Sound Symbol Example Sound

Consonants

| | |
|------|----------------------|
| [p] | pat |
| [t] | tom |
| [k] | cat |
| [b] | boy |
| [d] | dip |
| [g] | garment |
| [m] | mat |
| [n] | nut |
| [ŋg] | sing |
| [f] | five |
| [v] | dove |
| [θh] | thistle |
| [ðh] | feather |
| [s] | sat |
| [z] | haze |
| [ʃh] | smash |
| [ʒh] | ambrosia |
| [çh] | chic |
| [jʰ] | page |
| [l] | lick |
| [w] | kiwi |
| [r] | parse |
| [y] | yew |
| [h] | horse |
| [q] | uh-oh (glottal stop) |
| [dx] | butter |
| [nx] | winter |
| [el] | thistle |

Vowels

| | |
|--------|-----------|
| [iy] | lily |
| [ih] | miss |
| [ey] | lazy |
| [eh] | mess |
| [ae] | after |
| [aa] | pop |
| [ao] | orchestra |
| [uh] | wood |
| [ow] | lotus |
| [uw] | tulip |
| [uh] | butter |
| [er] | bird |
| [ay] | item |
| [aw] | flower |
| [oy] | toil |
| [y uw] | few |
| [ax] | ruffian |
| [ix] | lip |
| [axr] | leather |
| [ux] | dude |

Consonants and vowels in the ARPAbet phonetic alphabet

Chapter 17. Speech Recognition and Understanding Systems

17.2 The Speech Understanding Study Group

The Speech Understanding Study Group

- **Feasibility study on a system that can recognize speech**
 - Larry Roberts in DARPA and Cordell Green in U.S. Army in early 1970
- **Meeting on speech processing**
 - Carnegie Mellon University at the end of March 1970
 - Form a 'study group' to make recommendations concerning the launching of DARPA supported project in speech understanding.
- **First meeting of the study group**
 - BBN on May 26 and 27, 1970
- **Final meeting of the study group**
 - SDC on July 26-28, 1970

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17.3 The DARPA Speech Understanding Research Program

17.3.1 Work at BBN




■ SPEECHLIS

- Answer spoken questions about the moon rocks database

■ HWIM

- Travel budget manager's automated assistant
- Respond to spoken questions

17.3.2 Work at CMU

- **Dragon** 
 - Designed to understand sentences about chess moves by James K. Baker
 - First examples of the use of Hidden Markov Models in AI.
- **HARPY** 
 - Bruce T. Lowerre designed and implemented the system
 - Understand spoken sentences and answer questions about, and to retrieve documents from, a database containing abstracts of AI papers
- **HEARSAY-II** 
 - Understand spoken sentences and answer questions about, and to retrieve documents from, a database containing abstracts of AI papers
 - Blackboard architecture

Appendix 작성시 이 슬라이드에 있는 이미지를 이용하여 슬라이드 하이퍼링크 넣을것

17.3.3 Summary and Impact of the SUR Program

- More thorough search of potential solutions
- More thorough built-in knowledge of transition phenomena between adjacent words
- More thorough testing, tuning, and debugging

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17.4 Subsequent Work in Speech Recognition

Subsequent Work in Speech Recognition

- HMM approach in DRAGON was ultimately adopted by all the leading speech recognition companies
- DARPA began funding speech recognition work again as part of its Strategic Computing program in 1984
- Dragon introduced Dragon NaturallySpeaking, a speech recognition program for personal computers

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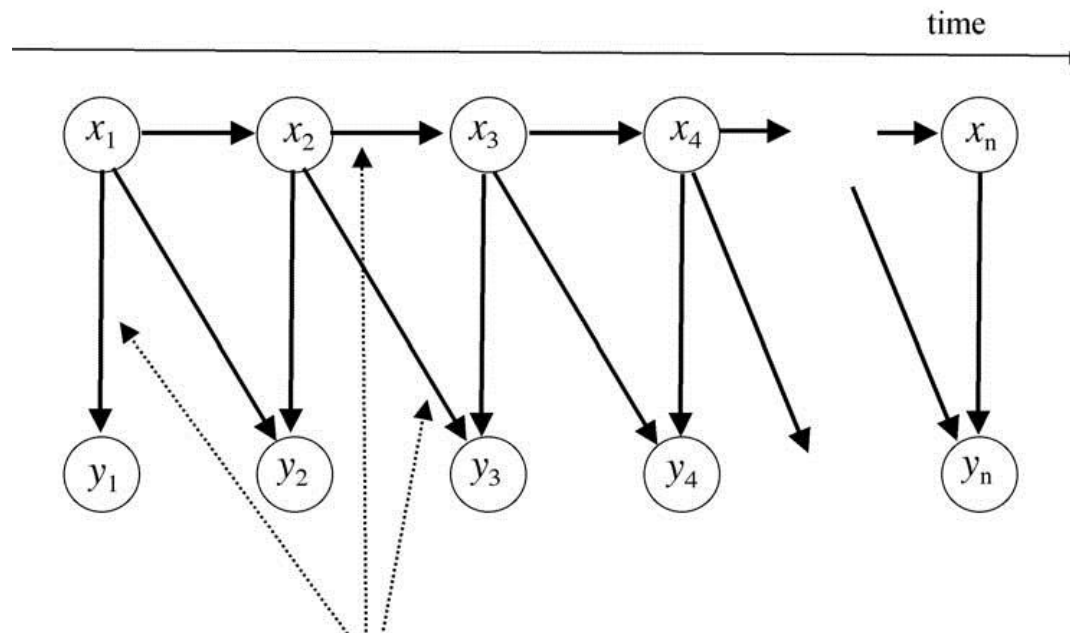
Appendix



17.3.2 Work at CMU

■ Dragon

- Designed to understand sentences about chess moves by James K. Baker
- First examples of the use of Hidden Markov Models in AI.



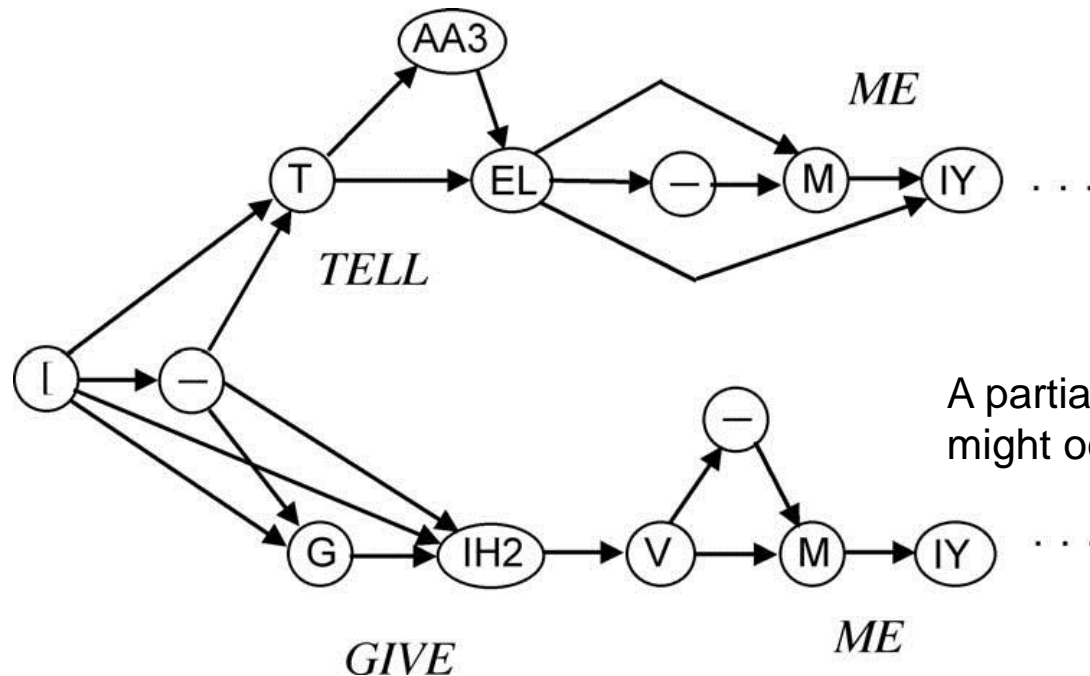
Two hierarchical levels in speech generation.



17.3.2 Work at CMU

■ HARPY

- Bruce T. Lowerre designed and implemented the system
- Understand spoken sentences and answer questions about, and to retrieve documents from, a database containing abstracts of AI papers



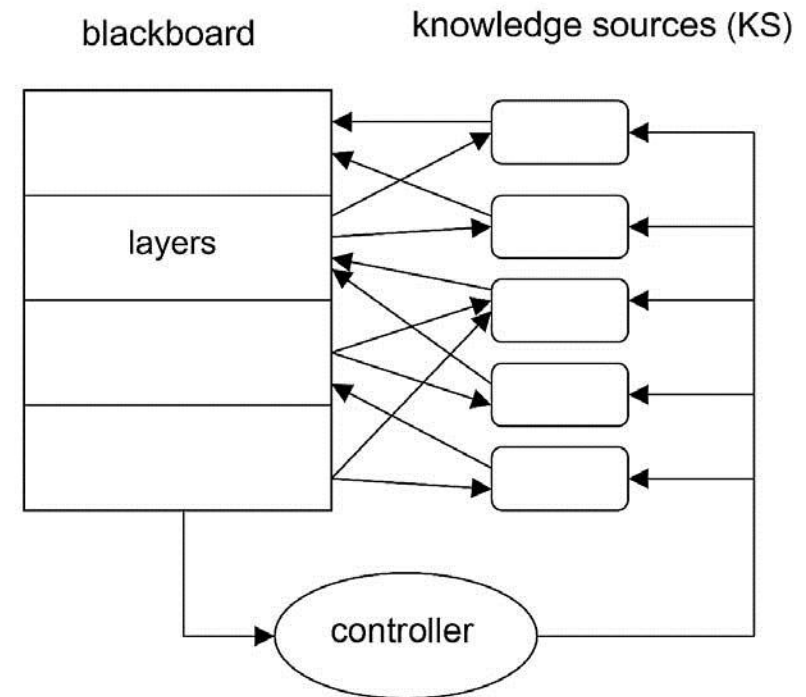
A partial network of the phones that might occur in a spoken sentence

17.3.2 Work at CMU



■ HEARSAY-II

- Understand spoken sentences and answer questions about, and to retrieve documents from, a database containing abstracts of AI papers
- Blackboard architecture



The Blackboard architecture