

Speech recognition and synthesis

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Introduction

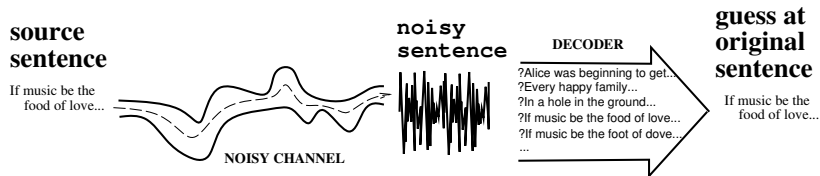
Speech recognition in Human Machine interaction

- A full interaction requires human input
- Input with speech is often faster and easier than with text or pointers
 - Over the phone
 - With large or unlimited choice, eg, person and place names
 - Free text, eg, dictation messages
 - With hands occupied, eg, while driving
- Sometimes speech input is ineffective
 - In a noisy surrounding, eg, a train station
 - With small menu based selections
 - Large variation in speakers, eg, second language speakers
 - Tasks that are difficult to describe verbally, eg, routing on a map

Many pictures (and their copyrights) are from [Jurafsky and Martin(2000)]



Automatic Speech Recognition



ASR is a database retrieval problem

- A speech recognizer is a clever example database
- The problem is: How to retrieve the most likely words from the acoustic signal
- Break down into two problems: Get the most likely
 - word candidates given the sound
 - word sequence given the available word candidates
- Currently both problems are solved stochastically

Speech Input: How to partition the ASR problem

What is the most likely word sequence given the observed sound:

$$\underset{Words}{\operatorname{argmax}} P (Words|Observation) =$$

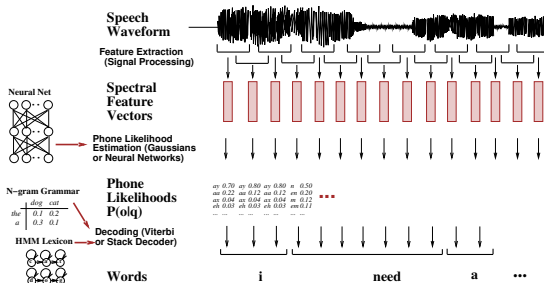
$$\underset{Words}{\operatorname{argmax}} \frac{P (Observation|Words) \cdot P (Words)}{P (Observation)}$$

Split this into two separate tasks

- $P (Observation)$ is a normalization constant, independent of word recognition (ignore it)
- $P (Observation|Words)$ is the acoustic *likelihood* of the words
- $P (Words)$ is the *prior* of the word sequence (i.e. the language model)



Speech Input: An overview of ASR



Sound waveform to word sequence

- Encode the waveform into Spectral Features
- Determine word likelihoods $P(\text{Sound}|\text{Words})$ for each word
- Determine word sequence probability $P(\text{Words})$ for each sequence

Language Prior: Word sequences

Estimate $P(\text{Words}) =$

$$P(w_1, \dots, w_n) = \prod_{i=1}^n P(w_i | w_1 \dots w_{i-1})$$

Approximate $P(\text{Words})$ by modelling $P(w_i | w_1 \dots w_{i-1}) \approx$

- $P(w_i | \text{State}_\alpha)$: Finite State Grammar
- $P(w_i | w_{i-n+1} \dots w_{i-1})$: N-gram
- $\sum_\alpha P(w_i | \text{Tree}_\alpha(w_1 \dots w_{i-1})) \cdot P(\text{Tree}_\alpha(w_1 \dots w_{i-1}))$: Context Free Grammar with (lexicalized) tree structures build from $(w_1 \dots w_{i-1})$



Language Prior: N-grams

Collect *word*, *word-pair* and *word-triplet* frequencies [Goodman(2001)]

- Impossible to get frequencies of all possible bi/trigrams
- Construct smoothed probability distributions
- Special "states" for sentence start and "end"
- $P(\text{Words}) \approx P(w_i | w_{i-2}, w_{i-1})$
- Use interpolation or backoff, eg, $P(w_i | w_{i-2}, w_{i-1}) \approx \alpha \cdot P(w_i | w_{i-1})$ if the tri-gram (w_{i-2}, w_{i-1}, w_i) was not observed



Language Prior: Data Oriented Parsing (CFG Example) [?]

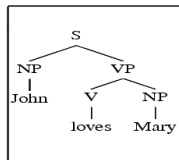


Fig. 1. A toy treebank

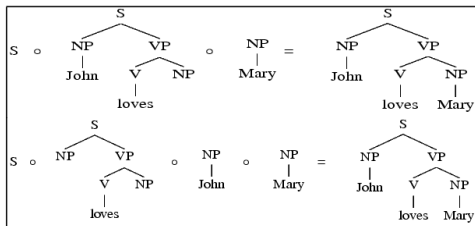


Fig. 2. Two different derivations of the same parse

Subtree have occurrence and insertion probabilities

- Requires a treebank with frequencies
- Correct normalization of probabilities
- Computationally expensive, like all probabilistic CF parsers

Language Prior: Grammar Perplexity

$$\text{Perplexity}(\mathcal{G}) = 2^{H(\mathcal{G})}$$

where

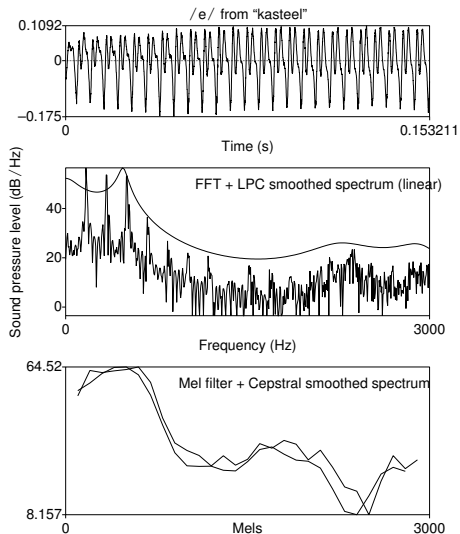
$$H(\mathcal{G}) = \sum_{w_i} -P(w_i|w_1 \dots w_{i-1}) \cdot \log_2 P(w_i|w_1 \dots w_{i-1})$$

For a tri-gram grammar this corresponds to:

- $P(w_i|w_{i-2}, w_{i-1}) = \frac{P(w_{i-2}, w_{i-1}, w_i)}{P(w_{i-2}, w_{i-1})}$
- Perplexity corresponds to the difficulty of predicting the next word
- A lower perplexity is better for ASR



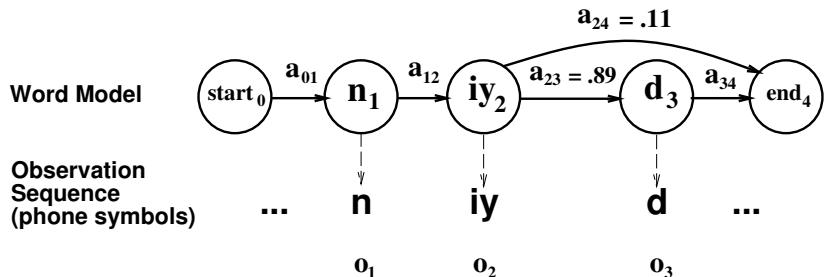
Spectral analysis: FFT, LPC, PLP, MFCC, filter-banks



- Need a spectral representation
- FFT: too noisy
- LPC: wrong sensitivity
- Resolution of the ear (Mel Freq, PLP, Filter banks)
- Sound level in dB (PLP, Filter banks)
- Spectral shape (MFCC)



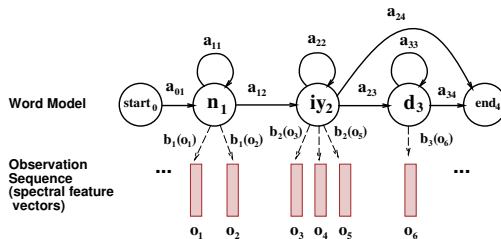
Hidden Markov Models: Markov chains



Word models: simple phone state model for *need*

- Each transition has a probability
- **start** and **end** are special states
- Each state or each transition has associated sound observations with a distinct probability density function (PDF)

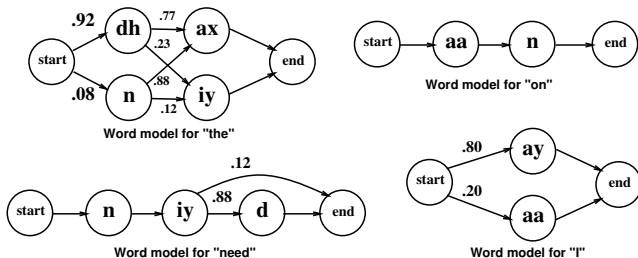
Hidden Markov Models: Observation probabilities



Observed are sound "spectra" for time "frames"

- Observation sequences have a probability
- Calculate this probability for each possible word
- Probabilities of O_i calculated from all possible underlying states
- Chose word *sequence* with the highest overall probability

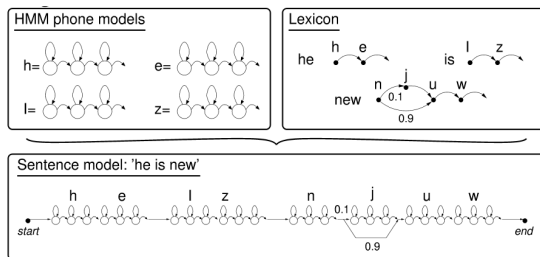
Hidden Markov Models: Pronunciation networks



Construct phone state models for each word in the dictionary

- The possible pronunciations for each word have to be encoded in the dictionary
- The transition probabilities are "trained" from the frequency of occurrence of the pronunciation in the speech corpus

Hidden Markov Models: Phone networks



Phone models are concatenated into utterance networks

- Each word model is itself a Markov finite state network of phone models
- Phones and word are connected through the *start* and *end* states (not shown)

Hidden Markov Models: Context Sensitive Phone lattices

Phone models are constructed of subphone states in context

- Each phone model is itself a Markov finite state network
- For each phoneme context separate phone models are constructed
- Each sub-phone context sensitive state can have it's own observation PDF
- For the sake of reducing training, the observation PDF's of different states are *tied* (i.e. made identical)



Hidden Markov Models: Context Sensitive Phone lattices

[CSLU()]

Oregon Graduate Institute
of Science and Technology

Context-Dependent Modeling (vocabulary independent)

divide each phoneme into 1, 2, or 3 parts.

example: "yes" /y E s/:

\$sil<y y>\$mid \$front<E <E> E>\$fric \$mid<s s>\$sil

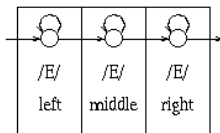
|-----|
/E/ model

previous phoneme

front
mid
back
sil
nasal
retro
fric
other

8 broad contexts

current phoneme



17 categories per 3-part phoneme

next phoneme

front
mid
back
sil
nasal
retro
fric
other

8 broad contexts

Center for Spoken Language Understanding (CSLU)



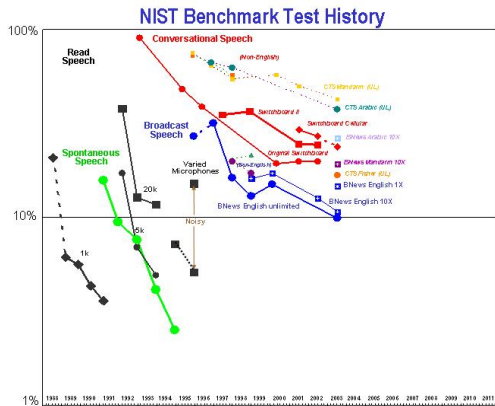
Evaluation: NIST, DARPA, hubs and spokes

The National Institute of Standards (NIST) and the DARPA program organize evaluation "contests" for ASR systems

- Tests contain mandatory core components *hubs*
- Tests contain optional specialized components *spokes*
- Tests evolve to include not only Speech-to-Text but also who spoke when, speaker localization etc.
- Includes varying speech material and conditions
- Contestants get training materials from the organization
- After time for training, contestants receive test speech and have to return the results



Evaluation: NIST results [Pallett(2003)]



- WER (vertical) go down over time
- More complex tasks introduced over time

Assignment: Week 7 Tone recognition

Recognize level and rising tones

- New → *Create PitchTier... level 0 0.6*
- Modify → *Add point... 0.05 200 & Add point... 0.55 200*
- New → *Create PitchTier... rising 0 0.6*
- Modify → *Add point... 0.05 100 & Add point... 0.55 200*
- Add silences to both PitchTiers: *Add point... 0.049 0 & Add point... 0.551 0*
- Select PitchTier <level|rising> → *To Pitch... 0.02 60 40*
- Select Pitch <either one> Play → Hum
- Record your voice imitating the pitch → Periodicity → *To Pitch... <default settings>*
- Select Pitch <either one> AND Pitch <your voice>
→ *To DTW... 24 10 yes yes no restriction*
- Select DTW *dtw.level_rising* → Query - → *Get distance (weighted)*
- Compare distances. How do you think you could improve recognition?
- See Blackboard for complete description.



Further Reading I

See chapter 7.1, 7.2, 7.5 [Jurafsky and Martin(2000)]



P. Boersma.

Praat, a system for doing phonetics by computer.

Glot International, 5:341–345, 2001.

URL <http://www.Praat.org/>.



P. Boersma and D. Weenink.

Praat 4.2: doing phonetics by computer.

Computer program: <http://www.Praat.org/>, 2004.

URL <http://www.Praat.org/>.



CSLU.

CSLU Toolkit.

Web.

URL <http://cslu.cse.ogi.edu/toolkit/index.html>.



FSF.

GNU General Public License.

Web, June 1991.

URL <http://www.gnu.org/licenses/gpl.html>.



Joshua T. Goodman.

A bit of progress in language modeling.

Computer Speech and Language, 15:403–434, 2001.

URL <http://arxiv.org/abs/cs.CL/0108005>.

URL is extended preprint.



Further Reading II



E. Gouvêa.

The CMU Sphinx Group Open Source Speech Recognition Engines.

Web.

URL <http://cmusphinx.sourceforge.net/html/cmusphinx.php>.



ISIP.

The Mississippi State ISIP public domain speech recognizer.

Web, August 2004.

URL <http://www.cavs.msstate.edu/hse/ies/projects/speech/index.html>.



Daniel Jurafsky and James H. Martin.

Speech and Language Processing.

Prentice-Hall, 2000.

ISBN 0-13-095069-6.

URL <http://www.cs.colorado.edu/~martin/slp.html>.

Updates at <http://www.cs.colorado.edu/>



Kevin Lenzo.

The CMU Pronouncing Dictionary.

Web.

URL http://www.speech.cs.cmu.edu/SLM_info.html.



David S. Pallett.

A look at NIST's benchmark asr tests: Past, present, and future.

In *Proceedings of the 2003 IEEE Workshop on Automatic Speech Recognition and Understanding*, 2003.

URL http://www.nist.gov/speech/history/pdf/NIST_benchmark_ASRtests_2003.pdf.



Further Reading III



Project Gutenberg.

Project gutenberg free ebook library.

Web, 2005.

URL <http://www.gutenberg.org/>.



Roni Rosenfeld.

The CMU Statistical Language Modeling (SLM) Toolkit.

Web.

URL http://www.speech.cs.cmu.edu/SLM_info.html.



Rita Singh.

Robust group's open source tutorial learning to use the cmu sphinx automatic speech recognition system.

Web, 2005.

URL <http://www.cs.cmu.edu/~robust/Tutorial/opensource.html>.



Manual for the Sphinx-III recognition system.

SPHINX-CMU.

URL <http://fife.speech.cs.cmu.edu/sphinxman/>.



Paul A. Taylor, S. King, S. D. Isard, and H. Wright.

Intonation and dialogue context as constraints for speech recognition.

Language and Speech, 41:493–512, 1998.

URL http://www.cstr.ed.ac.uk/downloads/publications/1998/Taylor_1998_b.pdf.



Jean-Marc Valin.

Open mind speech.

Web.

URL <http://freespeech.sourceforge.net/>.



Further Reading IV



Xue Wang.

incorporating knowledge on segmental duration in hmm-based continuous speech recognition.

PhD thesis, LOT Netherlands Graduate School of Linguistics, 04 1997.

URL <http://www.fon.hum.uva.nl/wang/ThesisWangXue/TOCINDEX.html>.



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signature of Ty Coon, 1 April 1989
Ty Coon, President of Vice*

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