Speech Corpora, labeling and segmentation

Introduction
Language corpora
Use of corpora in Speech Technology
Annotation, Segmentation, and labeling
Phonetic symbols
Assignment
Bibliography

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Introduction

There is no data like more data

- Speech and Language are extremely complex
- Large amounts of data are necessary to model them
- “The best application is the one with the largest corpus”
- 10-1000 hours of speech recordings needed
- $10^8 - 10^9$ word text corpus needed
Introduction: Corpora for Speech and Language Technology

A language corpus is a documented collection of coherent text, speech, video, and transcriptions and annotations of these

Requirements

- Meta data (fixed)
- Normalization (fixed)
- Data (fixed)
- Transcriptions and annotations (cumulative)
- Storage, distribution, access, and software (volatile)

[Wynne(2005)]
Introduction: Corpora for S&L Technology

Requirements

- **Meta data (fixed): Information on the items**
  - Bibliographic/biographic information (author, speaker)
  - Dates
  - Origin, eg, place of publishing, recording
  - Language variant
  - Genre and style
  - Recording trail, post-processing, and formats
  - **Access criteria, Copyrights, Privacy & Ethical guidelines**
  - . . .

- **Normalization (fixed)**

- **Data (fixed)**

- **Transcriptions and annotations (cumulative)**

- **Storage, distribution, access, and software (volatile)**
Introduction: Corpora for S&L Technology

Requirements

- Meta data (fixed)
- Normalization (fixed): All items must adhere to certain guidelines
  - Inclusion/selection criteria
  - Recording and text formats
  - Spelling rules, orthographic normalization
  - Storage formats (sample frequencies, file formats)
  - ...

- Data (fixed)
- Transcriptions and annotations (cumulative)
- Storage, distribution, access, and software (volatile)
Introduction: Corpora for S&L Technology

Requirements

- Meta data (fixed)
- Normalization (fixed)
- Data (fixed): Immutable text or speech records
  - Broadcast recordings
  - Speech recordings
  - Video recordings
  - Original text
  - Transliterations of speech (correctable)
  - ...

- Transcriptions and annotations (cumulative)
- Storage, distribution, access, and software (volatile)
Introduction: Corpora for S&L Technology

Requirements

- Meta data (fixed)
- Normalization (fixed)
- Data (fixed)
- Transcriptions and annotations (cumulative): Added value of interpretations and analysis
  - Orthographic transcription (transliteration) of speech
  - Paragraph and sentence boundaries
  - Phonemic transcription
  - Prosodic transcription (e.g., ToBI)
  - Part-of-Speech tagging
  - Lemmatization
  - Syntactic trees (treebank)
  - ...
- Storage, distribution, access, and software (volatile)
Introduction: Corpora for S&L Technology

Requirements

- Meta data (fixed)
- Normalization (fixed)
- Data (fixed)
- Transcriptions and annotations (cumulative)
- Storage, distribution, access, and software (volatile): Practical usage
  - Digital storage, what and where
  - On-line and/or media distribution (DVD)
  - Access policies (pricing, licenses)
  - Exploration software
  - Database tables
  - DBMS
  - Updates and policy
  - ...

van Son & Weenink (IFA, ACLC)
Language corpora

Example corpora and their sizes

- IFA Corpus: 50 thousand words ($5 \frac{1}{2}$ hours) [Van Son(2003)]
- Spoken Dutch Corpus (CGN): 9 million words (800 hours) [NTU(2004)]
- British National Corpus (BNC): 100 million words [BNC(1997)]
- Twente journal corpus: 300 million words (Dutch) [Ordelman(2002)]
- Tilburg text corpus: 600 million words (Dutch, unpublished?)
- COSMAS corpus archive: 1.8 billion words (German) [IDS(2005)]
- IFA Video Dialog corpus: conversations (5 hours)
  http://www.fon.hum.uva.nl/IFA-SpokenLanguageCorpora/
Language corpora: CGN [NTU(2004)]

Contents (\(\frac{2}{3}\) Dutch, \(\frac{1}{3}\) Flemish)

- 500 hours (5,650,000 words) recorded in The Netherlands
- 300 hours (3,250,000 words) in Flanders
- 4250 speakers
- 15 Styles/genres
- Field recordings with Sony Minidisk
- 16/16 and 8/8 kHz/bit encoding
**Language corpora: CGN Styles and Genres**

CGN: 9 million words from 800 hours of speech

<table>
<thead>
<tr>
<th>Hour</th>
<th>kWords</th>
<th>Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>225</td>
<td>2,626</td>
<td>spontaneous conversations ('face-to-face')</td>
</tr>
<tr>
<td>51</td>
<td>565</td>
<td>interviews with teachers of Dutch (VNC)</td>
</tr>
<tr>
<td>92</td>
<td>1,209</td>
<td>spontaneous telephone dialogues</td>
</tr>
<tr>
<td>64</td>
<td>853</td>
<td>spontaneous telephone dialogues</td>
</tr>
<tr>
<td>11</td>
<td>136</td>
<td>simulated business negotiations</td>
</tr>
<tr>
<td>64</td>
<td>790</td>
<td>interviews/discussions/debates (broadcast)</td>
</tr>
<tr>
<td>36</td>
<td>360</td>
<td>discussions/debates/meetings (non-broad.)</td>
</tr>
<tr>
<td>44</td>
<td>405</td>
<td>lessons recorded in the classroom</td>
</tr>
<tr>
<td>21</td>
<td>208</td>
<td>live (eg sport) commentaries (broadcast)</td>
</tr>
<tr>
<td>17</td>
<td>186</td>
<td>newsreports/reportages (broadcast)</td>
</tr>
<tr>
<td>36</td>
<td>368</td>
<td>news (broadcast)</td>
</tr>
<tr>
<td>15</td>
<td>146</td>
<td>commentaries/columns/reviews (broadcast)</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>ceremonious speeches/sermons</td>
</tr>
<tr>
<td>16</td>
<td>141</td>
<td>lectures/seminars</td>
</tr>
<tr>
<td>104</td>
<td>903</td>
<td>read speech (read books)</td>
</tr>
</tbody>
</table>
Language corpora: CGN Annotations

Annotations and transcriptions

- Orthographic transcription (the full 8,900,000 words)
- Manually verified POS tagging and lemmatization (all)
- Lexicon and identification of multi word units (all)
- Automatic time alignment and phonetic transcription at the word level (all)
- Manually verified broad phonetic transcription (1,000,000 words)
- Manually verified time alignment at the word level (1,000,000 words)
- Syntactic annotation (1,000,000 words)
- Two independent prosodic annotations (250,000 words)
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Use of corpora in Speech Technology: Research

Phonetic, prosodic and syntactic research

- Phoneme durations
- Stress and Accent placement
- Intonation and expressive speech (emotions)
- Part-of-Speech tagging
- Prosodic and syntactic boundaries
- Phoneme assimilation (eg, word boundaries)
- Pronunciation variation
- Morphological decomposition
- Visual speech
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Use of corpora in Speech Technology: TTS Modeling

Text to Speech synthesis

- Produce accentuation and boundaries from text
- Produce phoneme durations from text
- Grapheme-to-phoneme conversion (lexicon)
- Chunk words into groups (punctuation)
- Decompose words into components (compound words)
Use of corpora in Speech Technology: ASR Modeling

Automatic Speech Recognition

- Hidden Markov Model training
- Speech templates for template based recognition
- Language model (smoothed N-grams)
- Pronunciation variation
- Treebank training (syntactic probabilities)
Annotation, Segmentation, and labeling: Orthography

Manual Orthographic transcription (transliteration) is used to automatically generate

- Tokens (words) ⇒ Word alignment
- Phonemic transcription ⇒ Phone alignment
- POS tags

All annotations and segmentation can be manually verified (at great cost)
Annotation, Segmentation, and labeling: POS tagging

POS tags are used to automatically generate

- Lexical stress
- Syntactic structure
- Lemmas
- Prosodic structure (ToBI) ⇒ currently only by hand

All annotations and segmentation can be manually verified (at great cost)
Speech corpora needed an unambiguous digital encoding of IPA symbols (now there is **UNICODE**)

- **Language specific encodings**
  - 1 character ASCII encodings + diacritics (SAMPA)
  - 2 character ASCII encodings (SWITCHBOARD)

- **Complete IPA encodings**
  - 2 character ASCII encoding (eg, Worldbet [Hieronymus(1994)])
  - Control encodings (LaTeX Tipa, Praat)

- **Currently, control encodings are impractical for manual labeling**

- **Note that mapping sounds to the IPA is *not* trivial**
### Phonetic symbols: CGN’s SAMPA vs Worldbet encoding

<table>
<thead>
<tr>
<th>Vowels IPA</th>
<th>CGN</th>
<th>Wbet</th>
<th>Example</th>
<th>Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>I</td>
<td>'I '</td>
<td>llp</td>
<td>lip</td>
</tr>
<tr>
<td>e</td>
<td>E</td>
<td>'E '</td>
<td>lEx</td>
<td>leg</td>
</tr>
<tr>
<td>a</td>
<td>A</td>
<td>'A '</td>
<td>lAt</td>
<td>lat</td>
</tr>
<tr>
<td>o</td>
<td>O</td>
<td>'O '</td>
<td>bOm</td>
<td>bom</td>
</tr>
<tr>
<td>y</td>
<td>Y</td>
<td>'ux'</td>
<td>pYt</td>
<td>put</td>
</tr>
<tr>
<td>i</td>
<td>i</td>
<td>'i '</td>
<td>lip</td>
<td>liep</td>
</tr>
<tr>
<td>y</td>
<td>y</td>
<td>'y '</td>
<td>byr</td>
<td>buur</td>
</tr>
<tr>
<td>e</td>
<td>e</td>
<td>'e '</td>
<td>lex</td>
<td>leeg</td>
</tr>
<tr>
<td>e</td>
<td>2</td>
<td>'7 '</td>
<td>d2k</td>
<td>deuk</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>'a '</td>
<td>lat</td>
<td>laat</td>
</tr>
<tr>
<td>o</td>
<td>o</td>
<td>'o '</td>
<td>bom</td>
<td>boom</td>
</tr>
<tr>
<td>u</td>
<td>u</td>
<td>'u '</td>
<td>buk</td>
<td>boek</td>
</tr>
<tr>
<td>e</td>
<td>@</td>
<td>'&amp; '</td>
<td>x@-IE+k</td>
<td>gelijk</td>
</tr>
<tr>
<td>e</td>
<td>E+</td>
<td>'Ei'</td>
<td>wE+s</td>
<td>wijs</td>
</tr>
<tr>
<td>e</td>
<td>9+</td>
<td>'8y'</td>
<td>h9+s</td>
<td>huis</td>
</tr>
<tr>
<td>e</td>
<td>O+</td>
<td>'Ou'</td>
<td>kO+t</td>
<td>koud</td>
</tr>
</tbody>
</table>
Change intonation and duration

- Open sentence in praat (eg, assignment 1/2)
- Create a Word tier (Help → Praat Intro → Intro 7. Annotation)
- Add the (aligned) words to the tier
- Copy to a Phoneme tier
- Then add (split into) the phonemes
- Create a manipulation (Help → Praat Intro → Intro 8. Manipulation)
- Move the stress(-es) to a different word(s)
- What are the contributions of intonation, duration, or intensity?
- Hand in your report as a PDF
Further Reading I

**BNC.**

*Britisch National Corpus.*  
Corpus, 1997.  
URL http://www.natcorp.ox.ac.uk/.

**P. Boersma.**

*Praat, a system for doing phonetics by computer.*  

**P. Boersma and D. Weenink.**

*Praat 4.2: doing phonetics by computer.*  

**FSF.**

*GNU General Public License.*  

**James L. Hieronymus.**

*Ascii phonetic symbols for the world's languages: Worldbet.*  
Further Reading II

- **IDS.**
  - COSMAS.
  - Corpus, 2005.
  - URL http://corpora.ids-mannheim.de/~cosmas/.

- **NTU.**
  - Spoken Dutch Corpus (CGN).
  - Metadata (MPI) - http://www.mpi.nl/world/ISLE/overview/Overview_CGN.html

- Roeland Ordelman.
  - Twente Nieuws Corpus (TwNC).
  - Corpus, 2002.

  - IFA corpus 1.0.

  - Learning tone distinctions for Mandarin Chinese.
Further Reading III

M Wynne, editor.  
URL http://ahds.ac.uk/linguistic-corpora.  
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