Recent Improvements
in the CUED CTS SU System

M. Tomalin and P.C. Woodland

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Cambridge University

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Overview

• Error Analysis

• MDE and NLP

• Prosodic Feature GMMs

• Future Plans
Error Analysis

SRI+ and CUED Side Errors for CTS SUBD Eval04 data:
Error Analysis

c.200 DEL errors analysed by hand:

- **40.7 %**: before asyndetic clause boundary
  Ex: they destroyed all the national monuments (*) he destroyed a large area

- **20.4 %**: before co-ordinating conjunction
  Ex: that’s unbiased honesty (*) but then again


c.200 INS errors analysed by hand:

- **26.2 %**: before potential BackChannel
  Ex: just because * yeah well I mean I guess that’s unbiased

- **20.4 %**: before potential Discourse Marker
  Ex: on the other hand * well by telling the truth
MDE and NLP

Work in Progress:

Use NLP techniques to detect asyndetic clause boundaries:

- Generate rttm file containing putative SU boundaries
- Parse within each SU; detect possible clause boundaries
- Insert SU boundary if probability of clause boundary greater than threshold

Use RASP (Robust Automatic Statistical Parser) to obtain parse trees.
Prosodic Feature GMMs

Current Cart-style decision tree PFM s require

- training data to be downsampled.
- PFM probs to be divided by priors.

Preferable to model the data without downampling/dividing by priors...

Alternative: GMM-based PFM s:

- Use prosodic features that are modelled well using GMMs.
- Obtain prosodic feature vectors for each SU subtype in training data.
- Construct GMM for each SU subtype.
- Train GMMs using standard tools, increasing mixtures.
- Obtain prob from each SU subtype GMM for each feature vector in test data.
- Place GMM probs on arcs of lattice and decode as usual.

Initially, only pause modelled using GMMs...
Prosodic Feature GMMs

Distribution of pause features in RT-04 training data (pause > 0) for SU subtypes:
Prosodic Feature GMMs

GMMs were constructed that modelled pause:

- 50-50 downsampled CTS RT-04 training data
- 4 iterations of parameter re-estimation (MLE training)
- 4/8/16 Gaussian mixture components per state

Initial GMM results for dev03f test set:

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>DEL</th>
<th>INS</th>
<th>SUBS</th>
<th>%Err</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFM (pause)</td>
<td>41.8</td>
<td>41.1</td>
<td>32.4</td>
<td>115.3</td>
</tr>
<tr>
<td>GMM (pause) 4mix</td>
<td>39.4</td>
<td>54.3</td>
<td>26.3</td>
<td>120.1</td>
</tr>
<tr>
<td>GMM (pause) 8mix</td>
<td>39.9</td>
<td>50.6</td>
<td>27.8</td>
<td>118.4</td>
</tr>
<tr>
<td>GMM (pause) 16mix</td>
<td>39.7</td>
<td>52.4</td>
<td>28.2</td>
<td>120.3</td>
</tr>
<tr>
<td>SULM</td>
<td>37.3</td>
<td>17.1</td>
<td>9.1</td>
<td>63.4</td>
</tr>
<tr>
<td>SULM + PFM (pause)</td>
<td>35.2</td>
<td>12.3</td>
<td>10.5</td>
<td>58.0</td>
</tr>
<tr>
<td>SULM + GMM (pause) 4mix</td>
<td>36.4</td>
<td>11.5</td>
<td>11.8</td>
<td>59.7</td>
</tr>
<tr>
<td>SULM + GMM (pause) 8mix</td>
<td>36.0</td>
<td>10.3</td>
<td>11.2</td>
<td>57.5</td>
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<tr>
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<td>36.2</td>
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</tbody>
</table>

The 8mix GMM outperforms the PFM by 0.5% abs.
Future Plans

Current plans for Structural MDE research include the following:

- Continue exploring a GMM-based alternative to CART-style PFM*s

- Use discriminative training for GMMs

- Use NLP techniques to reduce DEL errors involving asyndetic clause boundaries

- Use a larger set of prosodic features in PFM*s