The NICT/ATR Speech Translation System for IWSLT 2008

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Tasks

- English-Chinese Challenge Task
- Chinese-English Challenge Task
- Pivot task

CleopATRa (Inhouse decoder)

- Phrase-based SMT system
- Log-linear model whose features are the same as those of the MOSES decoder
- Dynamic Interpolation
English-Chinese Challenge Task

Factors affecting English-Chinese SMT were examined

<table>
<thead>
<tr>
<th>system</th>
<th>devset</th>
<th>devset3</th>
<th>factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>org</td>
<td>0.4282</td>
<td>0.4301</td>
<td>Original BTEC</td>
</tr>
<tr>
<td>dict</td>
<td>0.4462</td>
<td>0.4363</td>
<td>Chinese word segmentation</td>
</tr>
<tr>
<td>cldc</td>
<td>0.4399</td>
<td>0.3834</td>
<td>CLDC-2004-863-0009</td>
</tr>
<tr>
<td>all</td>
<td>0.4963</td>
<td>0.4710</td>
<td>BTEC+CLDC</td>
</tr>
<tr>
<td>all+dict+cldc</td>
<td>0.4966</td>
<td>0.4691</td>
<td>Clustering</td>
</tr>
<tr>
<td>all+questions+declarations</td>
<td>0.5055</td>
<td>0.4743</td>
<td>Clustering</td>
</tr>
<tr>
<td>all+dict+cldc+q.+d.</td>
<td>0.5070</td>
<td>0.4745</td>
<td>Clustering</td>
</tr>
</tbody>
</table>

These BLEU scores were obtained without MERT.
Chinese word segmentation (CWS)

Comparison of the original CWS in the supplied BTEC training corpus with a re-segmentation of the same corpus +1.8% BLEU, +0.6 % BLEU

- Dictionary-based CWS system
- Viterbi-segmentation according to a language model
- Dictionary was augmented by the words in the BTEC corpus

CWS is important.
Additional Corpus

- MODEL = devset, devset3
- BTEC = 0.4462, 0.4363
- CLDC = 0.4399, 0.3834
- BTEC+CLDC = 0.4963, 0.4710

+5.01% BLEU, +3.47% BLEU

- BTEC was more suitable than CLDC-2004-863-0009
- Using BTEC and CLDC was very effective
Dynamic Interpolation

• Our decoder, CleopATRa, can linearly interpolate all the models from all the sub-systems according to a vector of interpolation weights that are supplied for each sentence to be decoded

• phrase-table, reordering-table, language model can be combined

Clusters made from the training data were used to make models
Clustering by corpora (1/2)

• BTEC and CLDC were regarded as classes
• \( \text{Pr}(\text{BTEC}|\text{sentence}) \) was the weight for BTEC
• Probabilities were learned by an ME classifier

<table>
<thead>
<tr>
<th>Class</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTEC</td>
<td>please input your pin number</td>
</tr>
<tr>
<td>BTEC</td>
<td>we want to have a table near the window</td>
</tr>
<tr>
<td>CLDC</td>
<td>yes please</td>
</tr>
<tr>
<td>CLDC</td>
<td>thank you sir</td>
</tr>
</tbody>
</table>
Clustering by corpora (2/2)

- MODEL = devset, devset3
- BTEC = 0.4462, 0.4363
- CLDC = 0.4399, 0.3834
- BTEC+CLDC = 0.4963, 0.4710
- BTEC, CLDC, BTEC+CLDC = 0.4966, 0.4691

The weight of “BTEC+CLDC” was fixed.

+0.03% BLEU, −0.19 % BLEU

Clustering by corpora was not effective
### Clustering by sentence type (1/2)

- Question sentences and non-question sentences were regarded as clusters.
- $\Pr(\text{Question} | \text{sentence})$ was the weight for the question model.
- Probabilities were learned by an ME classifier.

<table>
<thead>
<tr>
<th>Class</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>&lt;s&gt;_where &lt;s&gt;_where_do where where_do where_do_i ...</td>
</tr>
<tr>
<td>Q</td>
<td>&lt;s&gt;_how &lt;s&gt;_how_long how how_long how_long_is ...</td>
</tr>
<tr>
<td>NQ</td>
<td>&lt;s&gt;_the &lt;s&gt;_the_light the the_light the_light_was ...</td>
</tr>
<tr>
<td>NQ</td>
<td>&lt;s&gt;_i &lt;s&gt;_i_have i i_have i_have_a have_a ...</td>
</tr>
</tbody>
</table>
Clustering by sentence type (2/2)

- MODEL = devset, devset3
- BTEC+CLDC = 0.4963, 0.4710
- Questions, Non-questions, BTEC+CLDC = 0.5055, 0.4743

The weight of “BTEC+CLDC” was fixed.

+0.92% BLEU, +0.33 % BLEU

Clustering by sentence type was slightly effective
Combination of all models

- MODEL = devset, devset3
- BTEC+CLDC = 0.4963, 0.4710
- BTEC, CLDC, BTEC+CLDC = 0.4966, 0.4691
- Questions, Non-questions, BTEC+CLDC = 0.5055, 0.4743
- BTEC, CLDC, Questions, Non-questions, BTEC+CLDC = 0.5070, 0.4745

+0.15% BLEU, +0.02 % BLEU

Combination of all models was slightly effective.
Pivot Task

Strategies examined

• Cascade
• Pseudo corpus
• Phrase table composition
Cascade strategy (Baseline)

- SMT-1: Chinese sentence $\rightarrow$ English sentence
- SMT-2: English sentence $\rightarrow$ Spanish sentence
- SMT-1 + SMT-2: Chinese sentence $\rightarrow$ English sentence $\rightarrow$ Spanish sentence
Pseudo Corpus

- English–Chinese training data → EC-SMT system
- Spanish–English training data → English part → EC-SMT system → Translated Chinese (100-best) → Spanish–Translated Chinese training data → SC-SMT system
- English–Spanish training data → ES-SMT system
- Chinese–English training data → English part → ES-SMT system → Translated Spanish (100-best) → Chinese–Translated Spanish training data → SC-SMT system
Phrase table composition

\[
\phi(\bar{s} | \bar{c}) = \sum_{\bar{e} \in T_{SE} \cap T_{EC}} \phi(\bar{s} | \bar{e}) \phi(\bar{e} | \bar{c})
\]

- \(\bar{s}, \bar{c}, \bar{e}\): Spanish, Chinese, and English phrases
- \(T_{SE}, T_{EC}\): Spanish-English, English-Chinese phrase-tables
- \(\phi(\bar{s} | \bar{e}), \phi(\bar{e} | \bar{c})\): Phrase translation probability

Lexicalized reordering models were also induced.
Comparison of BLEU

1. Cascade = 0.2529
2. Pseudo Corpus (EC-SMT) = 0.2860
3. Pseudo Corpus (ES-SMT) = 0.2740
4. Phrase-table induction = 0.2703
5. Linear interpolation (2+3+4) = 0.3050
Summary

- **English–Chinese translation Challenge Task:**
  Chinese word segmentation and external resources had a significant impact on the translation results

- **Chinese–English translation Challenge Task:**
  We used a novel clustering method based on WER

- **PIVOT Task:**
  We integrated two strategies for pivot translations by linear interpolation.