The NAIST Machine Translation System for IWSLT 2012

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Overview

- Phrase-based machine translation
- Built on Moses (experiment management system)
- Evaluated on TED Translation:
  - English → French official track
  - XXX → English other tracks

Focus:
- easily implementable
- language-independent
- methods
English-French
Summary of English-French

- Four successful statistical methods:
  - Phrase-table smoothing
  - Language model interpolation
  - Calibrated minimum Bayes risk decoding
  - Large-scale data with filtering
- Combination raises BLEU 29.75 → 31.81
- Ablation tests to examine the factors
Phrase Table Smoothing

- Phrase probabilities for rare phrases over-fit the training data
- Smoothing discounts observed counts when calculating probabilities
- Here we test Good-Turing smoothing [Foster 06]
Smoothing Results

The NAIST Machine Translation System for IWSLT 2012

Smoothing Results

<table>
<thead>
<tr>
<th></th>
<th>dev2010</th>
<th>tst2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Smoothing</td>
<td>25</td>
<td>+0.30</td>
</tr>
<tr>
<td>Good-Turing</td>
<td>+0.62</td>
<td></td>
</tr>
</tbody>
</table>

BLEU
Language Model Interpolation

- LM data from heterogeneous sources
  - TED, News Commentary, Europarl, Giga
- Combine using simple linear interpolation
- Maximize likelihood of development set [Jelinek 80]
Language Model Interpolation Results

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<table>
<thead>
<tr>
<th></th>
<th>dev2010</th>
<th>tst2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>TED Only</td>
<td>+1.50</td>
<td>+1.71</td>
</tr>
<tr>
<td>Without Interp</td>
<td>+2.25</td>
<td>+2.37</td>
</tr>
<tr>
<td>With Interp</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Minimum Bayes Risk Decoding

- **Normal Decoding**: Choose the translation with highest probability
- **MBR Decoding**: From an n-best list, choose the translation with the lowest expected loss [Kumar 04]
- **Lattice MBR Decoding**: MBR over lattices [Tromble 08]
- Also tested **calibrating** the probability distribution
Minimum Bayes Risk Results

![Chart showing BLEU scores for dev2010 and tst2010, comparing No MBR, MBR, Lattice MBR, and Calibration.](chart.png)
Large-Scale Data with Filtering

• Giga-word English-French corpus is large, but noisy
• Train a classifier to detect noisy sentences
  • Features: Model 1, Alignment, Length Ratio, Same Word
• Use pseudo-negative training examples by swapping 30% of sentences [Mediani 2011]
Data Filtering Results

- TED+NC+EP
- +Unfiltered GIGA
- +Filtered GIGA

BLEU

dev2010: +0.42 +0.44

Tst2010: +0.38 +0.29
Other Methods Investigated

- Out of domain TM data
- Word alignment methods + combination
- Lexical reordering models
- MERT vs. PRO tuning

See the paper for more details!
XXX-English Language Pairs
Linguistic Family Tree

- **Indo-European** Family:
  - Germantic: German (de), Dutch (nl), English (en)
  - Italic: Portuguese (pt), Romanian (ro)
  - Slavic: Polish (pl), Russian (ru), Slovak (sk)

- **Afro-Asiatic** Family: Arabic (ar)

- **Altaic** Family: Turkish (tr)
MT Issues

- **Morphology:**
  - pl/ru/sk (fusional)
  - tr (agglutinative)
  - de/nl (compounding)
  - pt/ro (some inflection)

- **Word order:**
  - de/nl (SOV, V2)
  - ar (VSO)
Summary of XXX-English Systems

- **Common EMS setup:** compare performance of existing techniques cross-linguistically

- **What worked generally:**
  - Unsupervised Morphology
    - Using Morfessor and compound-splitter.perl
  - Gigaword LM
Unsupervised Morphology

- **Compound-splitter.perl [Koehn 03]**
  - Breaks apart words if subparts are seen in training data over a certain frequency

- **Morfessor 1.0 [Creutz 02]**
  - Use Minimum Description Length principle to find a small set of morphemes that covers the training words
  - Discovers both free & bound morphemes
  - Small modification: Morfessor segments too aggressively for unknown words, so keep OOV as is
Vocabulary Growth Rate
Morphology Results

- **Compound Split**
- **Morfessor**

<table>
<thead>
<tr>
<th>Language</th>
<th>Compound Split</th>
<th>Morfessor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ar</td>
<td>+1.5</td>
<td>+1.5</td>
</tr>
<tr>
<td>de</td>
<td>+0.5</td>
<td></td>
</tr>
<tr>
<td>nl</td>
<td>+0.2</td>
<td>+0.2</td>
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<tr>
<td>pl</td>
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<td>pt</td>
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<tr>
<td>sk</td>
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</tr>
<tr>
<td>tr</td>
<td>+1.0</td>
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</tr>
</tbody>
</table>
Language Model Addition

- Added additional Giga-Word language model
Other Methods Investigated

- Out of domain TM data
- Lattice-based MBR

See the paper for more details!
Thank You!