Look it up: Bilingual and Monolingual Dictionaries
Improve Neural Machine Translation

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Rare Word Problem

• Still a challenge in NMT

• Dictionaries:
  – Useful in rule-based MT and Statistical MT
  – Not commonly used in NMT
How Dictionaries Are Used

大家 都 知道 死海正在死亡  Everyone knows the Dead Sea is dying
我哥哥听说我们做了火药  Well, my brother heard that we had made gunpowder

死海  Dead Sea
火药  gunpowder
append

大家 都 知道 死海正在死亡  Everyone knows the Dead Sea is dying
我哥哥听说我们做了火药  Well, my brother heard that we had made gunpowder
死海  Dead Sea
火药  gunpowder
Our Approach

Original sentence: 大家 都 知道 死海(UNK) 正在 死亡

Unknown word: 死海

Dictionary Entry: 死海: the Dead Sea
Results on Word Based Models

Word-based results in BLEU

- Baseline
- Append
- Attach (ours)

ZH-EN Spoken
ZH-EN Science
ZH-EN Laws
ZH-EN News
ZH-EN Education
ZH-EN Subtitles
ZH-EN Thesis
ZH-EN All
DE-EN Small
DE-EN All
Results on BPE Based Models

BPE-based results in BLEU

BLEU

Zh-En Spoken  Zh-En Science  Zh-En Laws  Zh-En News  Zh-En Education  Zh-En Subtitles  Zh-En Thesis  Zh-En All  De-En Small  De-En All

Baseline  Append  Fuse  Attach
Macro F1 on BPE Based Models

BPE-based results in Macro F1

- Baseline
- Append
- Fuse
- Attach

The College of Engineering at the University of Notre Dame
Macro F1 on BPE Based Models

BPE-based results in Macro F1

<table>
<thead>
<tr>
<th>Model</th>
<th>Macro F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farsi-panlex</td>
<td>18.5</td>
</tr>
<tr>
<td>Farsi-wikidata</td>
<td>19.5</td>
</tr>
<tr>
<td>Farsi-combined</td>
<td>19.5</td>
</tr>
</tbody>
</table>

Baseline: Blue
Append: Red
Attach: Green
<table>
<thead>
<tr>
<th>Source sentence BPE:</th>
<th>我哥哥听说我们做了火@@药。</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dictionary Entry:</td>
<td>火药: gunpowder</td>
</tr>
<tr>
<td>Reference:</td>
<td>Well, my brother heard that we had made gunpowder.</td>
</tr>
<tr>
<td>BPE Baseline:</td>
<td>My brother had heard that we did a fire pills.</td>
</tr>
<tr>
<td>Attach:</td>
<td>My brother heard that we did the gunpowder.</td>
</tr>
</tbody>
</table>
Conclusion

• Definitions not equal to translations.
• Don’t force the NMT to generate definitions.
• Appending dictionaries may hurt the system.
• Attaching dictionaries improves translation quality and can work on monolingual dictionaries.