Example-based Machine Translation using Structural Translation Examples

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Proposed System
Proposed System

Parses an Input Sentence

Selects Structural Translation Examples

Combines them to generate an output tree

Decides the word-order
Structural Translation Examples

- The Advantage of High-Usability

- BUT: It requires many technologies
  - Parsing & Tree Alignment (are still being developed)

→ A naive method without such technologies may be efficient in a limited domain
Outline

• Algorithm
  – Alignment Module
  – Translation Module

• Experimental Results

• Conclusion
System Frame Work

- **Alignment module**
  - Builds Translation Examples from Bilingual Corpus

- **Translation module**
  - Selects Translation Examples
  - Combines them into a Translation
Alignment Module (1/2)

- A sentence pair is analyzed by parsers [Kurohashi1994][Charniak2000]
- Correspondences are estimated by Dictionary-based Alignment method [Aramaki 2001]
• **Translation example**
  
  = A combinations of correspondences which are connected to each other

- With **Surrounding phrases** (= the parent and children phrases of correspondences)

• for Selection of Translation Examples
System Frame Work

- **Alignment module**
  - Builds Translation Examples from Bilingual Corpus

- **Translation module**
  - Selects of Translation Examples
  - Combines them into a Translation
Translation Module (1/2)

**INPUT**

```
中国語の新聞を下さい (Chinese: Give me newspaper)
```

**TRANSLATION EXAMPLE**

```
Give me newspaper
```

---

- **Equality**: The number of equal phrases
- **Context Similarity**: calculated with a Japanese thesaurus
- **Alignment Confidence**: the ratio of content words which can be found in dictionaries
Translation Module (1/2)

**INPUT**

\[
\text{新聞を} \quad \text{(新聞を)}
\]

\[
\text{下さい} \quad \text{(give)}
\]

**Chinese**

\[
\text{中国語の} \quad \text{(Chinese)}
\]

**TRANSLATION EXAMPLE**

\[
\text{Give} \quad \text{me}
\]

\[
\text{newspaper}
\]

**Equality**: The number of equal phrases

**Context Similarity**: calculated with a Japanese thesaurus

**Alignment Confidence**: the ratio of content words which can be found in dictionaries
• **Equality**: The number of equal phrases

• **Context Similarity**:  
  – calculated with a Japanese thesaurus

• **Alignment Confidence**:  
  – the ratio of content words which can be found in dictionaries
Translation Module (1/2)

• **Equality**: The number of equal phrases

• **Context Similarity**:  
  – calculated with a Japanese thesaurus

• **Alignment Confidence**:  
  – the ratio of content words which can be found in dictionaries
Translation Module (2/2)

• Selection
  – Score: $= (\text{Equality} + \text{Similarity}) \times (\lambda + \text{Confidence})$

• Combine
  – The dependency relations & the word order in the translation examples are preserved
  – The dependency relations & the word order between the translation examples are decided by heuristic rules
Exception: Shortcut

If a Translation Example is almost equal to the input ➞ the system outputs its target parts as it is.

- Almost equal
  = Character-based DP Matching Similarity > 90%
Outline

• Algorism
  – Alignment Module
  – Translation Module

• Experimental Results

• Conclusion
Experiments

• We built Translation Examples from training-set (only given in IWSLT)

<table>
<thead>
<tr>
<th></th>
<th>bleu</th>
<th>nist</th>
<th>wer</th>
<th>per</th>
<th>gtm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev-set</td>
<td>0.38</td>
<td>7.86</td>
<td>0.52</td>
<td>0.45</td>
<td>0.66</td>
</tr>
<tr>
<td>Test-set</td>
<td>0.39</td>
<td>7.89</td>
<td>0.49</td>
<td>0.42</td>
<td>0.67</td>
</tr>
</tbody>
</table>

• Dev-set & Test-set score are similar
  ← the system has no tuning metrics for the dev-set.
The system without a corpus can generate translations using only the translation dictionaries. The score is not saturated ⇒ the system will achieve a higher performance if we obtain more corpora.
Subjective Evaluation

- Subjective Evaluation Result

<table>
<thead>
<tr>
<th>Fluency</th>
<th>3.650</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequacy</td>
<td>3.316</td>
</tr>
</tbody>
</table>

- Error Analysis
  - Most of the errors are classified into the following three problems:
    1. Function Words
    2. Word Order
    3. Zero-pronoun

5: "Flawless English"
4: "Good English"
3: "Non-native English"
2: "Disfluent English"
1: "Incomprehensible"
Problem 1: Function words

- The system selects translation examples using mainly content words
  ⇒ it sometimes generates un-natural function words
  – Determiners, prepositions

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>i'd like to contact my Japanese embassy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translation Example</td>
<td>I'd like to contact my bank</td>
</tr>
</tbody>
</table>
Problem 2: Word Order

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>is there anything a like local cuisine?</th>
</tr>
</thead>
</table>

- The word order between translation examples is decided by the heuristic rules.
- The lack of rules leads to the wrong word order.

Problem 3: Zero-pronoun

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>has a bad headache.</th>
</tr>
</thead>
</table>

- The input includes zero-pronoun.
  ⇒ outputs without a pronoun.
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Conclusions

- We described an EBMT system which handles Structural translation examples

- The experimental results shows the basic feasibility of this approach

- In the future, as the amount of corpora increases, the system will achieve a higher performance