Example-based Machine Translation using Structural Translation Examples

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Proposed System
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1. Parses an Input Sentence
2. Selects Structural Translation Examples
3. Combines them to generate an output tree
4. 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]

新聞を（give）
日本語の（Japanese）
新聞を（news paper）
下げ（give）

(S (VP (VBP Give) (NP (PRP me))) (NP (DT a) (JJ Japanese) (NN newspaper.))))
• **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**
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Bilingual Corpus → Alignment module → Translation Memory → Translation module

Input → Output
Translation Module (1/2)

**INPUT**

中国語の

obj
新聞を

(pos)
(Chinese)

給

(give)

**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)

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

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• **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%
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Experiments

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

| Auto. Eval. Result |
|-------------------|
| bleu | nist | wer | per | gtm |
| Dev-set | 0.38 | 7.86 | 0.52 | 0.45 | 0.66 |
| Test-set | 0.39 | 7.89 | 0.49 | 0.42 | 0.67 |

• 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

|        |        |
|--------|--------|
| Fluency| 3.650  |
| Adequacy| 3.316 |

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

• Error Analysis
  – Most of the errors are classified into the following three problems:
    (1) Function Words
    (2) Word Order
    (3) Zero-pronoun
Problem 1: Function words

| OUTPUT                      | I'd like to contact my Japanese embassy |
|-----------------------------|----------------------------------------|
| Translation Example         | I'd like to contact my bank             |

- The system selects translation examples using mainly content words
  ⇒ it sometimes generates un-natural function words
    - Determiners, prepositions
Problem 2: Word Order

| OUTPUT | is there anything a like local cuisine? |
|--------|----------------------------------------|

• 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

| OUTPUT | has a bad headache. |
|--------|---------------------|

• 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
