Translation as Parsing with a Synchronous Tree Grammar

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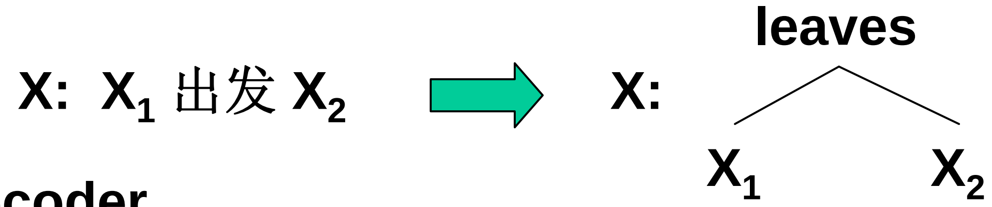
Overview

- Improving HierDec
  - Problems with a string-to-tree model
  - Extension to a tree-to-tree model
- Preliminary results
- Conclusions and future work

The HierDec System

- HierDec is BBN’s Hierarchical MT Decoder
  - From source-string to target-dependency-structure
  - Extended the string-to-string approach of Hiero (Chiang, 2005)

- Main Components
  - Rule extractor
    - Input: bi-lingual training data with GIZA alignment target parse trees
    - Output: string to dependency transfer rules, e.g.



  - Decoder
    - A chart parsing algorithm that produces a shared forest of target dependency structures
    - Using a target dependency LM on the fly

Problems of Using Target LMs Only

- An example from the last OntoNotes workshop
  - Source: 从 机场 送 父母 回来

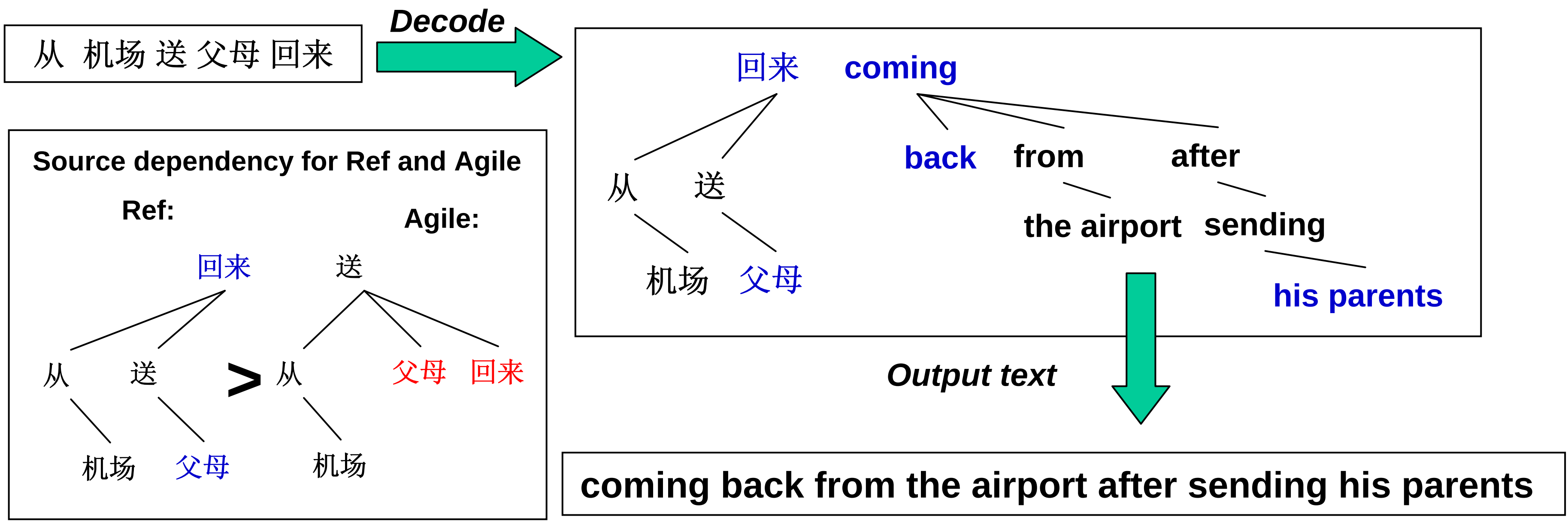
    from airport send parents to come back
  - Ref: *coming back* from the airport after sending *his parents*
  - Agile: from the airport to send *their parents* to *come back*
- Traditional string LMs prefer locally fluent translation
- Dependency LMs prefer grammatical translation
- A string-to-tree model does not employ any source side structural constraint to avoid incorrect application of translation rules

Solution: Using Source Dependency LM

- To generate source dependency structures in decoding to exploit the parallel source dependency relations
  - Building aligned dependency trees on both sides in parallel
  - Source dependency LM to measure the source analysis

Ref: *coming back* from the airport after sending *his parents*

Agile: from the airport to send *their parents* to *come back*



从 机场 送 父母 回来

Decode

回来 coming

从 送 back from after

机场 父母 the airport sending

his parents

Output text

coming back from the airport after sending his parents

Source dependency for Ref and Agile

Ref:

回来

从 送

机场 父母

>

Agile:

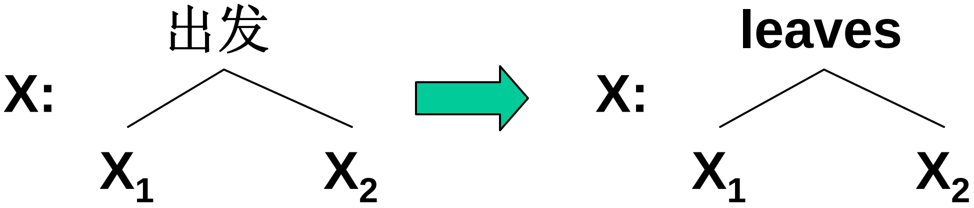
送

从 父母 回来

机场

HierDec in Dependency-to-Dependency Mode

- **Rule extraction**
  - **Input:**
    - **Bi-lingual training data with GIZA alignment**
    - **Target parse trees**
    - **Source parse trees**
  - **Output:**
    - **Dependency-to-dependency transfer rules, e.g.**



出发

X:

X_1 X_2

leaves

X:

X_1 X_2

- **Decoding**
  - **A chart parser that produces a shared forest of**
    - **Target dependency structures**
    - **Aligned source dependency structures**
  - **Using the source dep. LM score as an extra feature**

Experiments on MT06 and MT08

- **Experimental setup:**
  - **Test: MT06 and MT08 Chinese-English**
  - **Development: MT02-05, tuned on IBM BLEU**
  - **Training: GALE data with GIZA alignment; Source and target parse trees generated by two independent parsers.**
- **Results:**
  - **The dependency-to-dependency model does not show any improvement over the baseline, but they are very close.**

Model	**MT06**		**MT08**	
	BLEU	**TER**	**BLEU**	**TER**
string-to-dep	37.44	54.64	33.05	56.79
dep-to-dep	37.30	54.24	33.03	56.59

Experiments on MT06 and MT08 (cont')

- **Abnormal decrease in the number of transfer rules**
  - **The number is supposed go up: One string-to-dep rules would be splitted into several dep-to-dep rules due to the different analyses of the source dependency.**
  - **However, many more translation rules are discarded since the source side cannot be represented as a *well-formed* dependency structure.**

Model	**Number of Rules**
string-to-dep	41,013,346
dep-to-dep	39,213,131

- **Cause of the phenomenon:**
  - **The source and target trees generated by two independent parsers are inconsistent.**
- **The missing translation rules may result in the performance degradation.**

Conclusions

- **Parsing with a synchronous tree grammar (Shieber and Schabes, 1990) is empirically a tractable decoding algorithm for statistical MT.**
  - **A neat solution to employ source and target dependency relations jointly.**
- **Our first attempt does not shown improvement over a state-of-the-art string-to-dependency model, but it is promising.**
  - **Fixing existing flaws in the parsing model will give rise to performance improvement.**

Future Work in This Approach

- A bi-lingual parser
  - Trained from bi-lingual treebanks.
  - To parse the MT bi-lingual training data, and it guarantees better source and target tree consistency.
  - Self-training of the bi-lingual parser.
- To integrate alignment with bi-lingual parsing
  - From word-level alignment to hierarchical alignment