Rule-Based Reordering on Multiple Syntactic Levels in SMT

Ge Wu | September 3, 2014

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Outline

Introduction

- Rule-based pre-ordering approaches [Rottmann and Vogel 2007; Niehues and Kolss 2009; Herrmann et al. 2013]

- Hierarchical phrase-based model [Chiang 2007]

- More adaptive pre-ordering approach for Chinese based on syntactic structures

Preordering System

Rreordering Rules
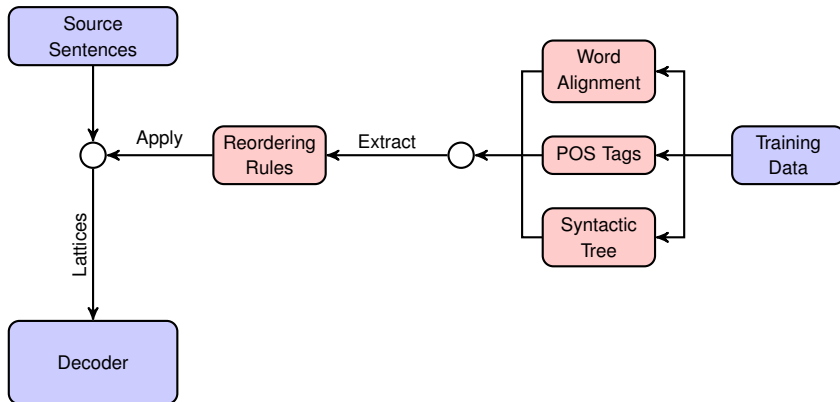
- **Short rules**

```
after the accident -> the accident after (0.5)

WRB MD DT -> DT WRB DT (0.3)
```

Rreordering Rules

- Short rules
- **Long rules**

        NN * MD -> * MD NN (0.14)

Rreordering Rules

- Short rules
- Long rules
- **Tree rules**

```
NP ( ADJP JJ NN ) -> JJ NN ADJP (0.16)
```

Chinese Word Orders
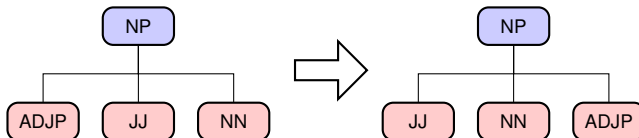
- **Premodifier instead of postmodifier**
    - Adverbials
    - Relative clauses
    - Preposition phrases
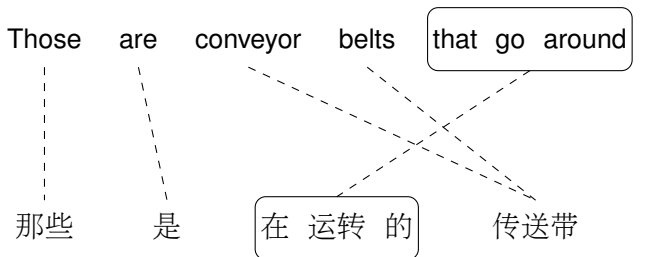
Those   are   conveyor   belts   │ that go around │   .

那些   是   │ 在 运转 的 │   传送带   。

Chinese Word Orders

- Premodifier instead of postmodifier
- **Questions**

How   will   you   cook   the   chicken   ?

You   will   how   cook   chicken   ?

你   会   怎么   做   鸡肉   呢   ?

Chinese Word Orders

- Premodifier instead of postmodifier
- Questions
- **Special sentence constructions**

There aren't many people around that are really involved with architecture as clients.

Never would India have thought on this scale before.
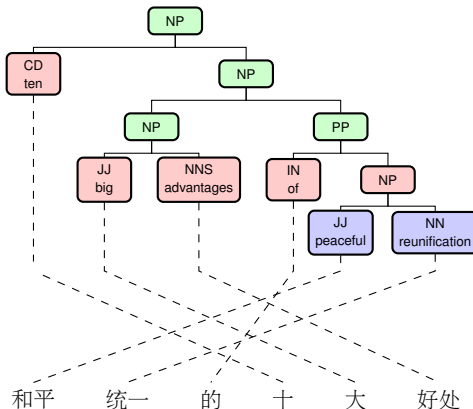
Chinese Word Orders

- Premodifier instead of postmodifier
- Questions
- Special sentence constructions
- **Long distance position change**

I find this very much disturbing when we are talking about what is going on right and wrong with democracy these days.
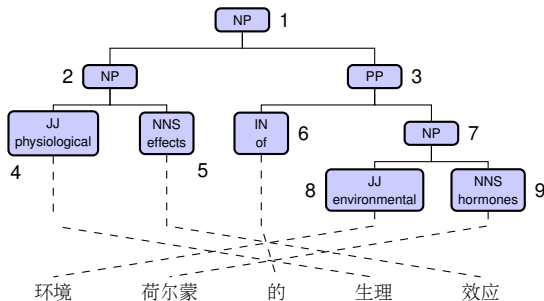
现在，每当我跟别人讨论我们的民主什么是对的，什么是错的我都为此觉得很无力。

Reordering on multiple syntactic levels

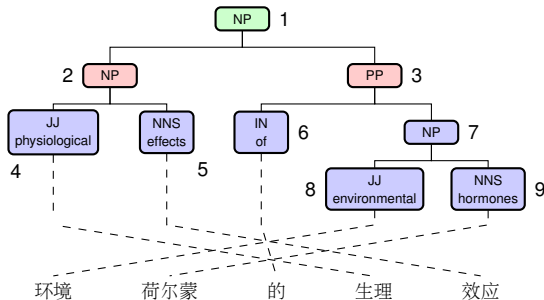Extension of tree rule based reordering to multiple syntactic levels

Reordering Patterns


```
Root #Level Pattern
```

Introduction

Multi-Level-Tree (MLT) Reordering

Evaluation

Conclusion

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Reordering Patterns
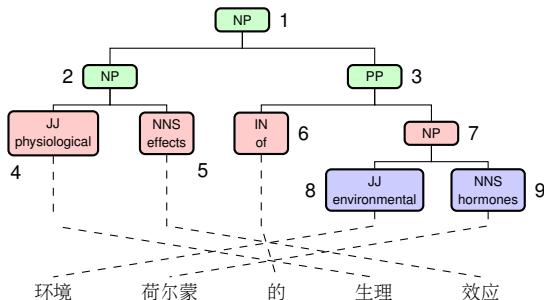


```
Root #Level Pattern
1    1      NP ( NP PP ) -> 1 0
```

Reordering Patterns
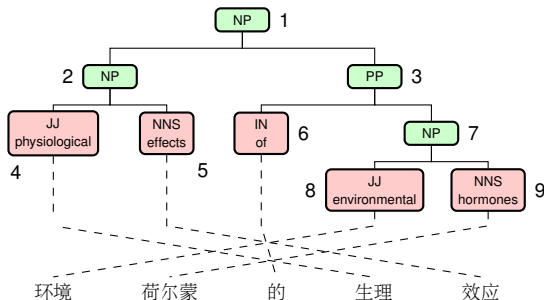


```
Root  #Level  Pattern
1     1       NP ( NP PP ) -> 1 0
1     2       NP ( NP ( JJ NNS ) PP ( IN NP ) ) -> 3 2 0 1
```

Reordering Patterns


```
Root  #Level  Pattern
1     1       NP ( NP PP ) -> 1 0
1     2       NP ( NP ( JJ NNS ) PP ( IN NP ) ) -> 3 2 0 1
1     3       NP ( NP ( JJ NNS ) PP ( IN NP ( JJ NNS ) ) ) -> 3 4 2 0 1
```

Reordering Patterns


```
Root  #Level  Pattern
1     1       NP ( NP PP ) -> 1 0
1     2       NP ( NP ( JJ NNS ) PP ( IN NP ) ) -> 3 2 0 1
1     3       NP ( NP ( JJ NNS ) PP ( IN NP ( JJ NNS ) ) ) -> 3 4 2 0 1
```
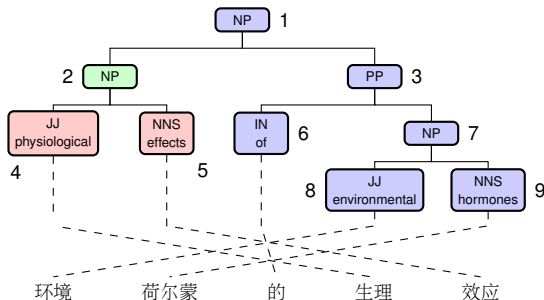
Reordering Patterns


```
Root  #Level  Pattern
1     1       NP ( NP PP ) -> 1 0
1     2       NP ( NP ( JJ NNS ) PP ( IN NP ) ) -> 3 2 0 1
1     3       NP ( NP ( JJ NNS ) PP ( IN NP ( JJ NNS ) ) ) -> 3 4 2 0 1
3     1       PP ( IN NP ) -> 1 0
```
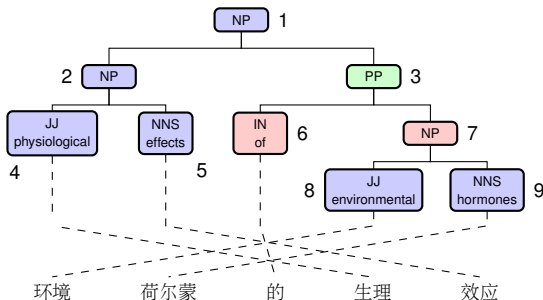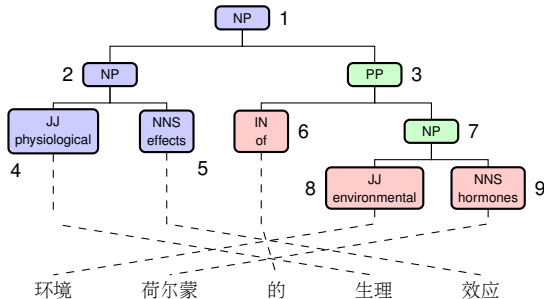
```
Root #Level  Pattern
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3     1      PP ( IN NP ) -> 1 0
3     2      PP ( IN NP ( JJ NNS ) ) -> 1 2 0
```

Reordering Patterns
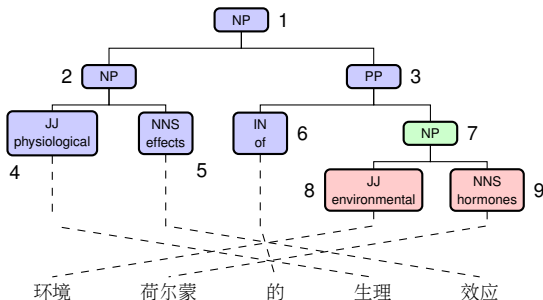


```
Root  #Level  Pattern
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1     3       NP ( NP ( JJ NNS ) PP ( IN NP ( JJ NNS ) ) ) -> 3 4 2 0 1
3     1       PP ( IN NP ) -> 1 0
3     2       PP ( IN NP ( JJ NNS ) ) -> 1 2 0
```

Rule Extraction

- **Search from all nodes with all possible depths**

Rule Extraction

- Search from all nodes with all possible depths
- **Search depth increases**

Rule Extraction

- Search from all nodes with all possible depths
- Search depth increases
- **Rule probability**

Rule Application

- **Search from all nodes with all possible depths**

Rule Application

- Search from all nodes with all possible depths
- **Search depth decreases**

```
PP ( IN NP ) -> NP IN
PP ( IN NP ( JJ NNS ) ) -> JJ NNS IN
```

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Rule Application

- Search from all nodes with all possible depths
- Search depth decreases

```
PP ( IN NP ) -> NP IN
PP ( IN NP ( JJ NNS ) ) -> JJ NNS IN
```

- **Reordering as path in word lattice**

Results: English −> Chinese

	BLEU Score	Improvement	TER
Baseline	12.07		72.15
+Short Rules	12.50	0.43	71.41
+Long Rules	12.99	0.92	70.71
+Tree Rules	13.38	1.31	68.27
+MLT Rules	13.81	1.74	68.20
Oracle Reordering	**18.58**	6.51	62.13
Long Rules	12.31	0.24	71.81
Tree Rules	13.30	1.23	70.42
MLT Rules	13.68	1.61	70.25

Results: Chinese -> English

	BLEU Score	Improvement	TER
Baseline	21.80		62.09
+Short Rules	22.90	1.10	61.64
+Long Rules	23.13	1.33	61.43
+Tree Rules	23.84	2.04	60.95
+MLT Rules	24.14	2.34	60.79
Oracle Reordering	**26.80**	5.00	56.97
Long Rules	22.10	0.30	62.21
Tree Rules	23.35	1.55	61.52
MLT Rules	23.96	2.16	60.83

Conclusion

- Better translation quality
- Better syntactic structure
- Space for further improvement

Outlook

- Better reordering approaches

-

- Vector presentation instead of POS tags as features
  - More possible reorderings
  - Improvement for more complicated reorderings

- Reordering with less information

Thank you for your attention

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