Transformation and Decomposition for Efficiently *Implementing* and *Improving* Dependency-to-String Model In Moses

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Joint work with Jun Xie, Andy Way and Qun Liu

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Motivation and Objectives

to make a dependency-based model available in Moses [Koehn et al., 2007]

Dependency-to-string (**Dep2Str**) model [Xie et al., 2011]

- to simplify the implementation of this model
  - **transformation** of dependency trees
- to improve this model to be comparable with Moses HPB [Chiang, 2005]
  - **decomposition** of dependency trees
    - sub-structural rules
    - pseudo forest

Overview of the Dep2Str Model

Training

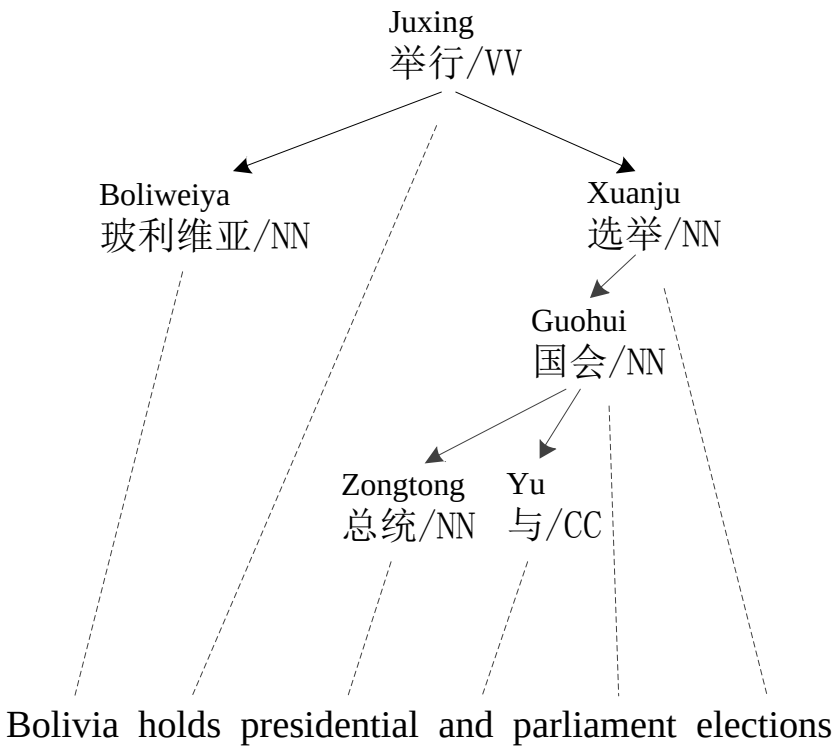

Figure: Rule extraction in the Dep2Str model

Overview of the Dep2Str Model

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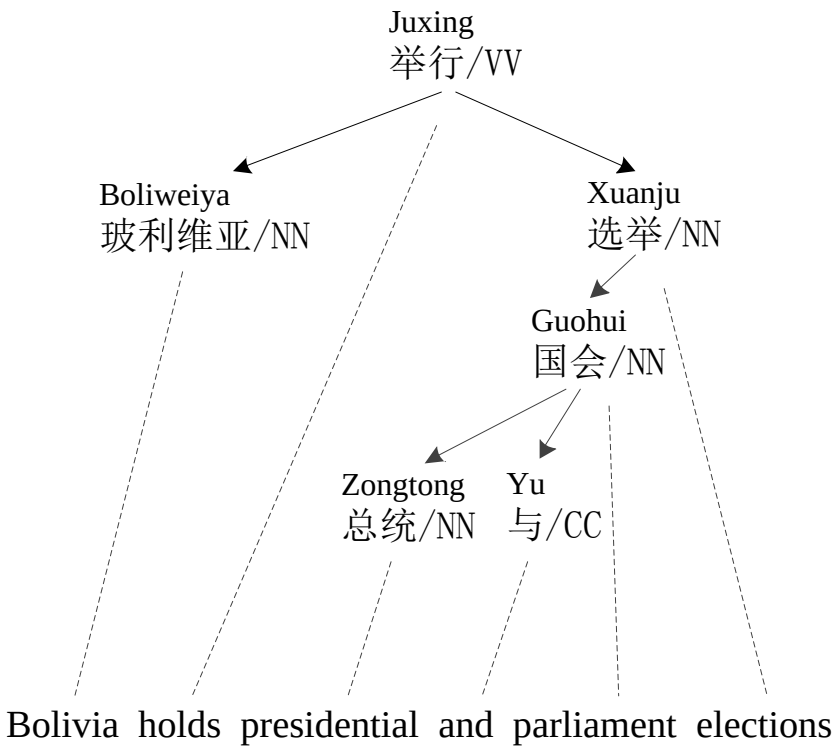
Head Rules



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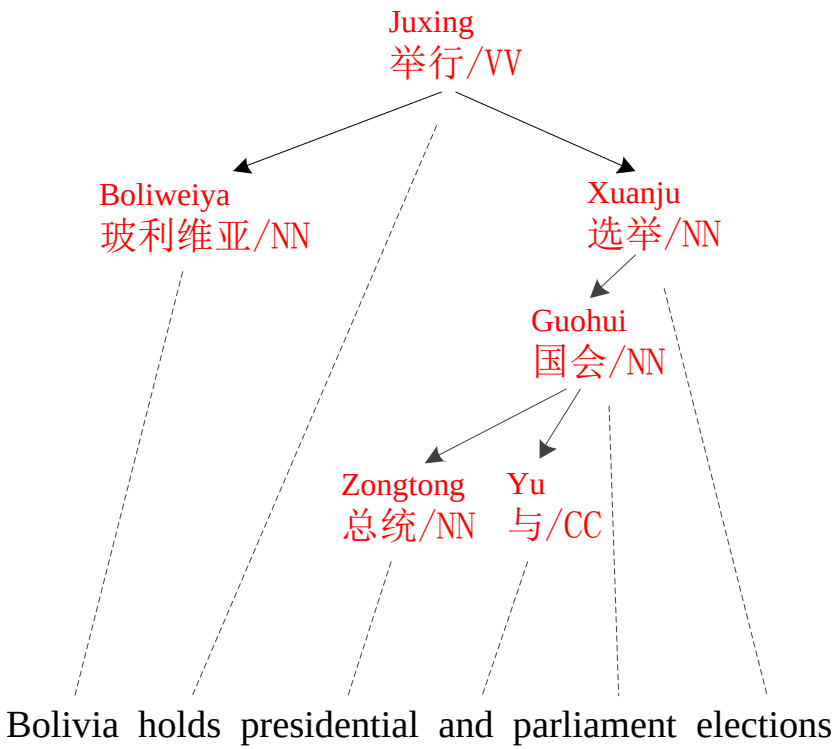

Head Rules

Boliweya 玻利维亚/NN ⇒ Bolivia

Yu 与/CC ⇒ and

Xuanju 选举/NN ⇒ elections

Zongtong 总统/NN ⇒ presidential

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Juxing 举行/VV ⇒ holds

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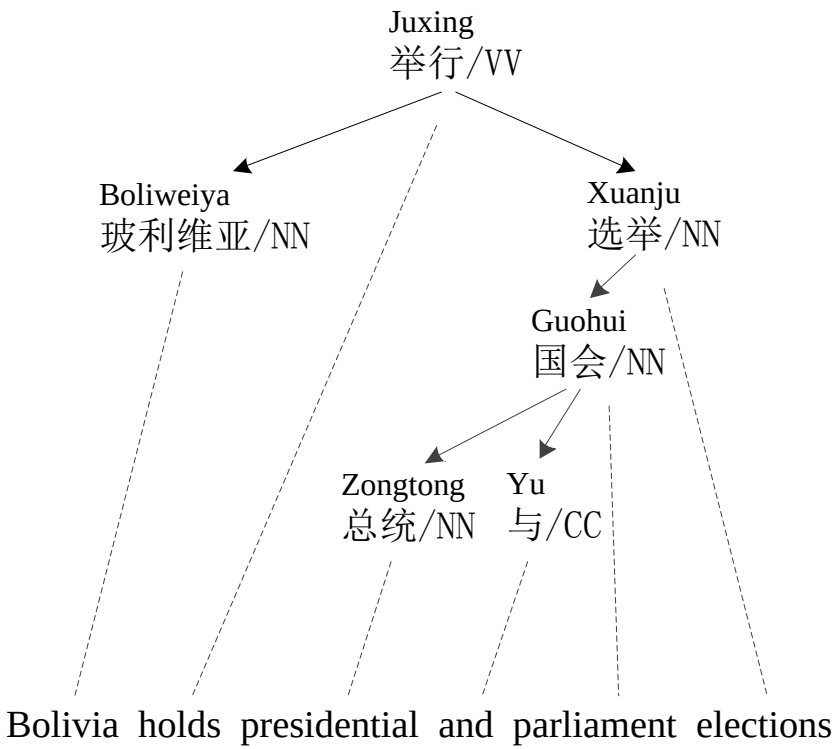

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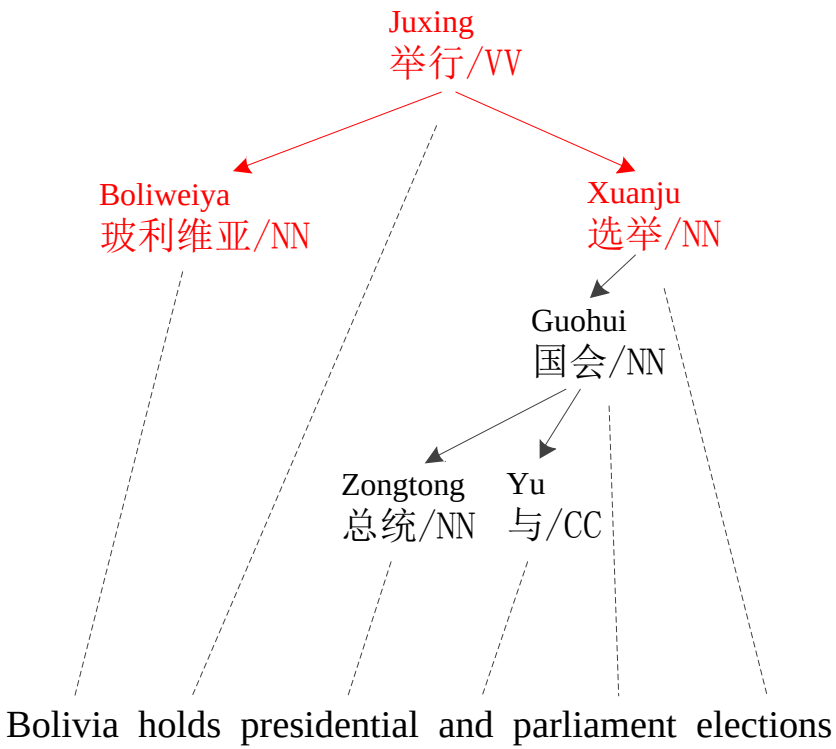

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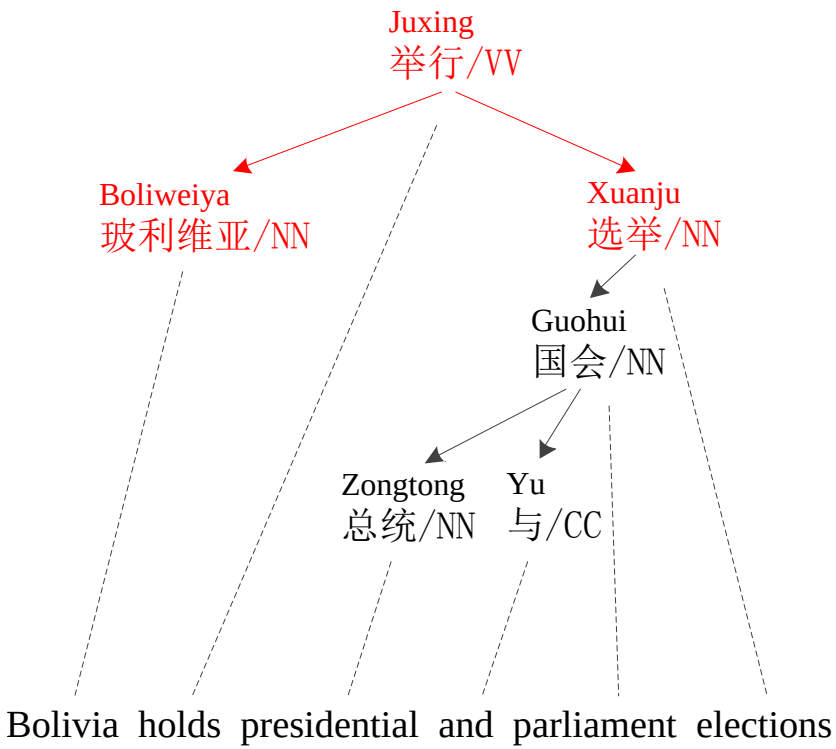

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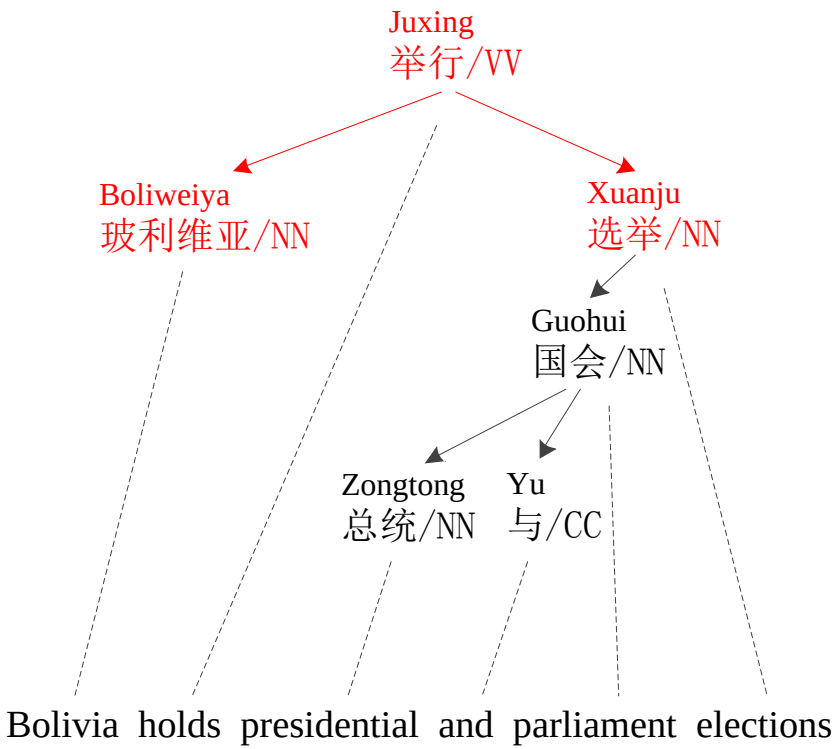

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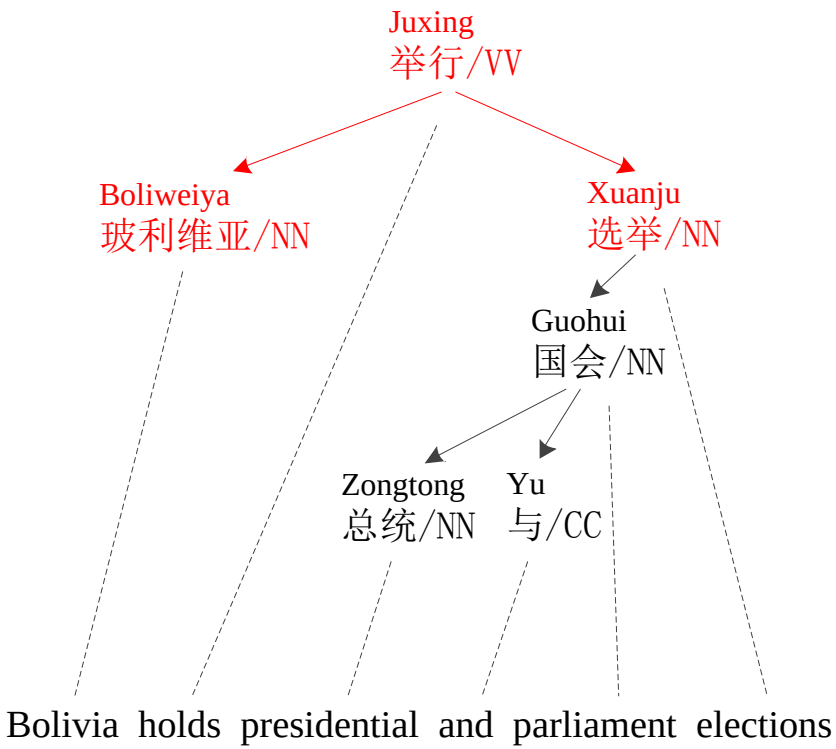

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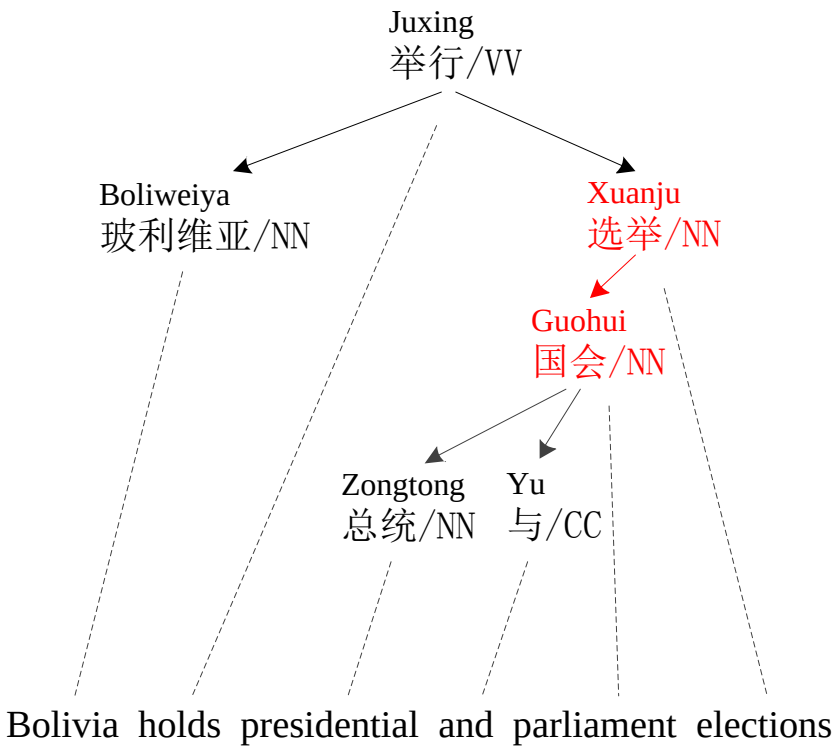

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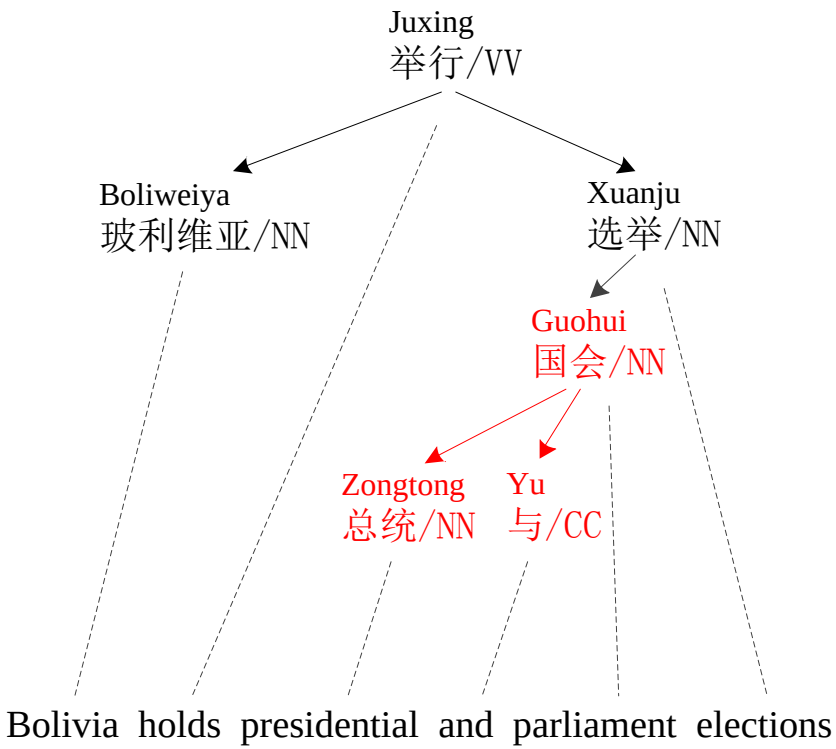

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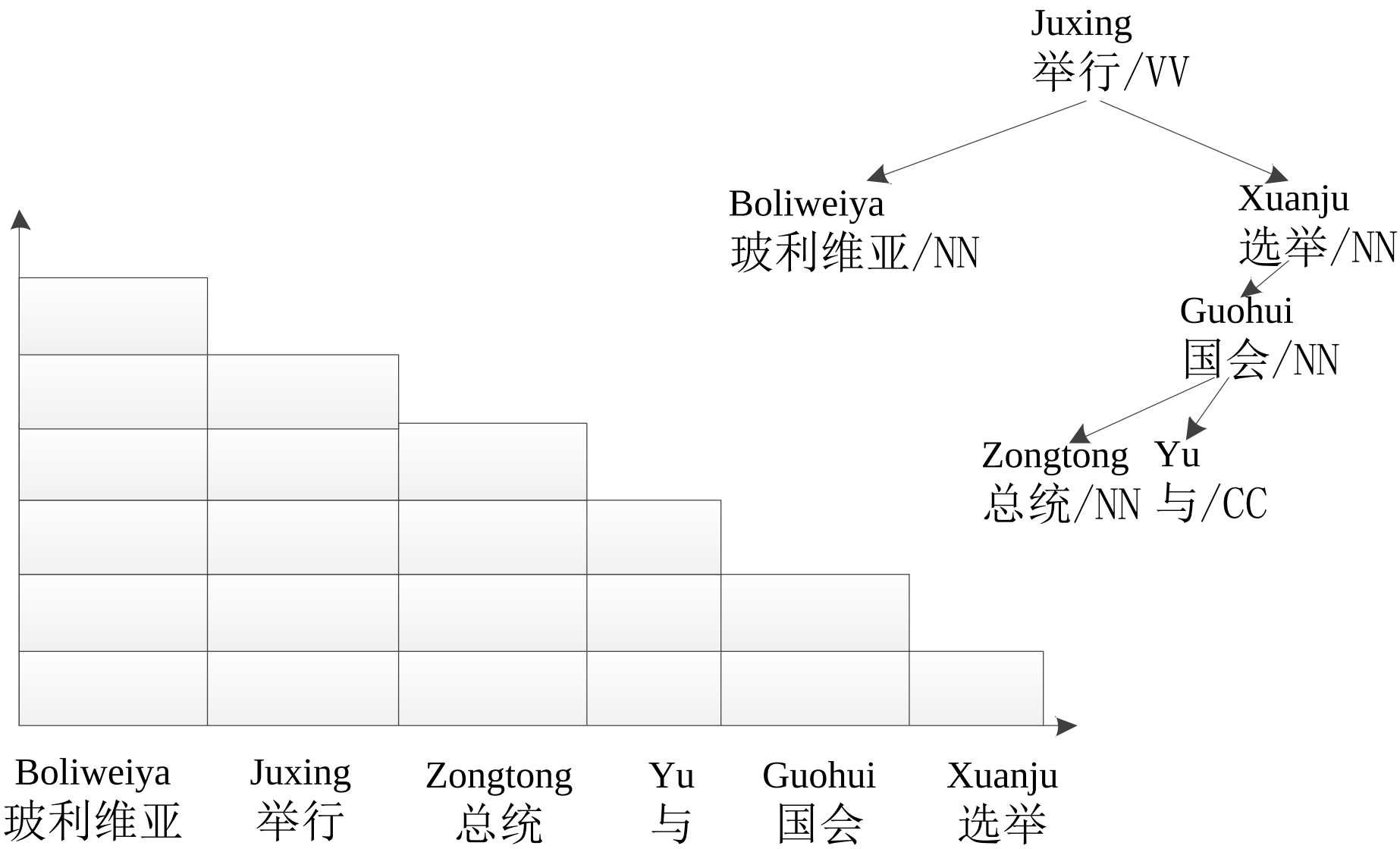

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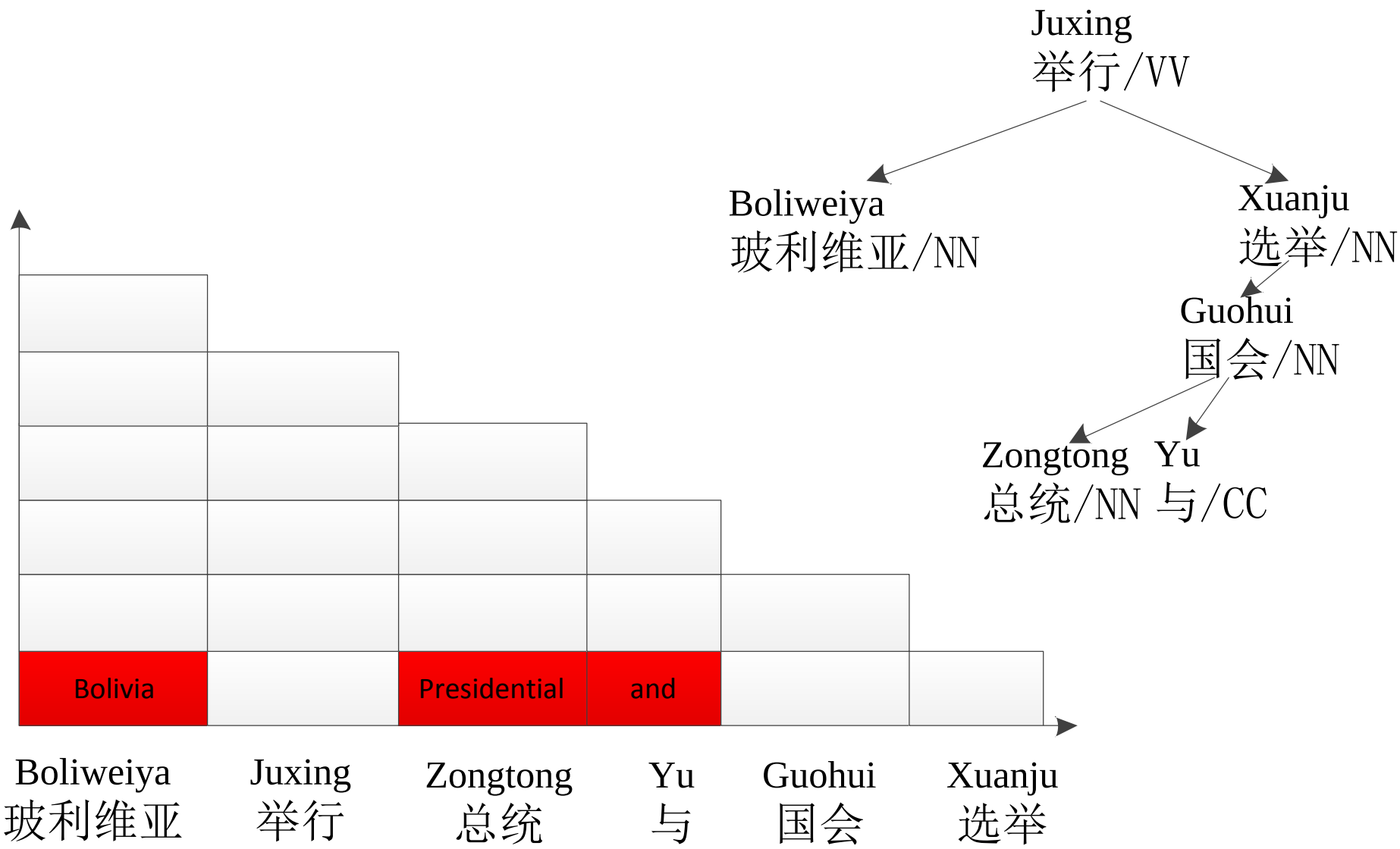

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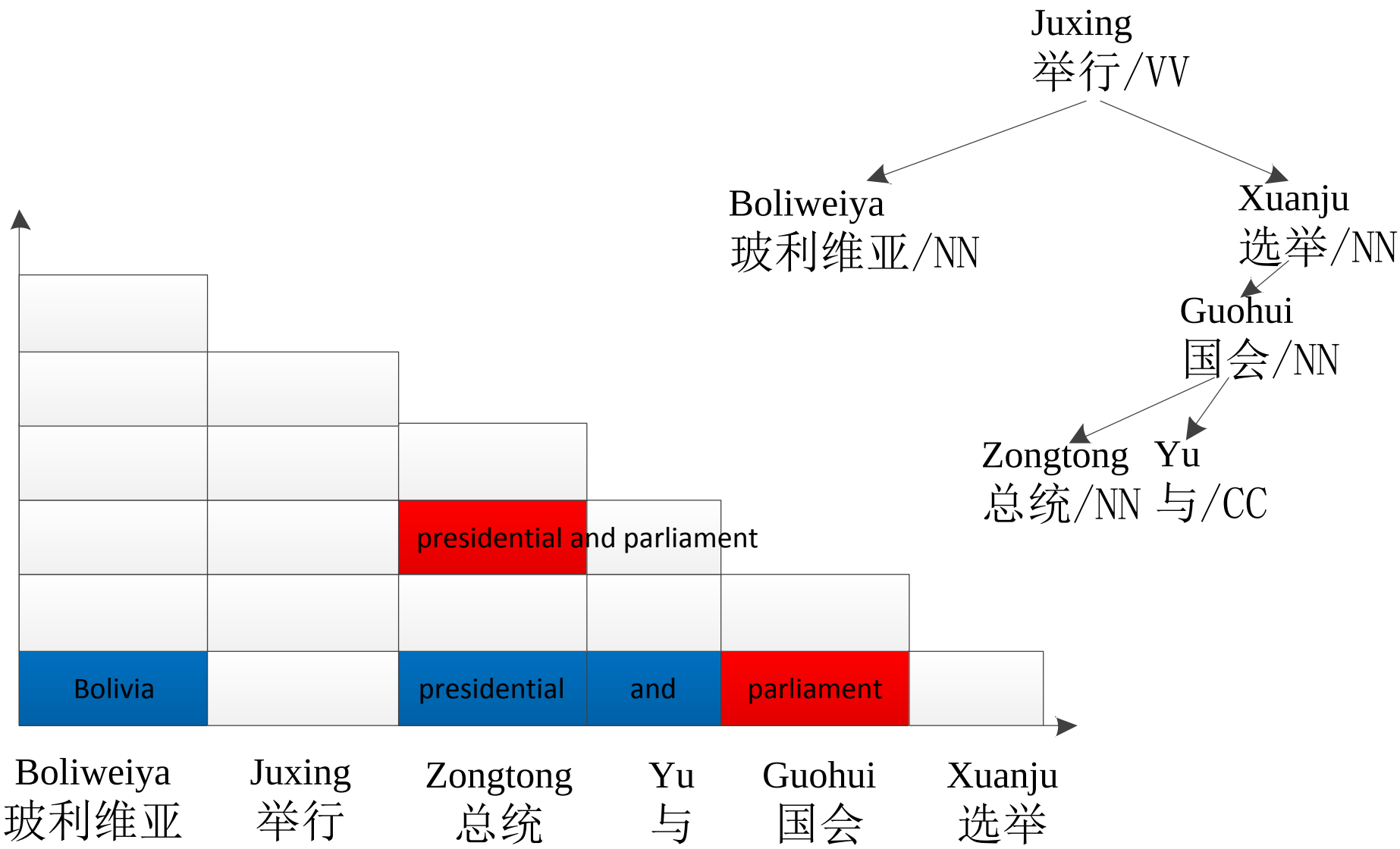

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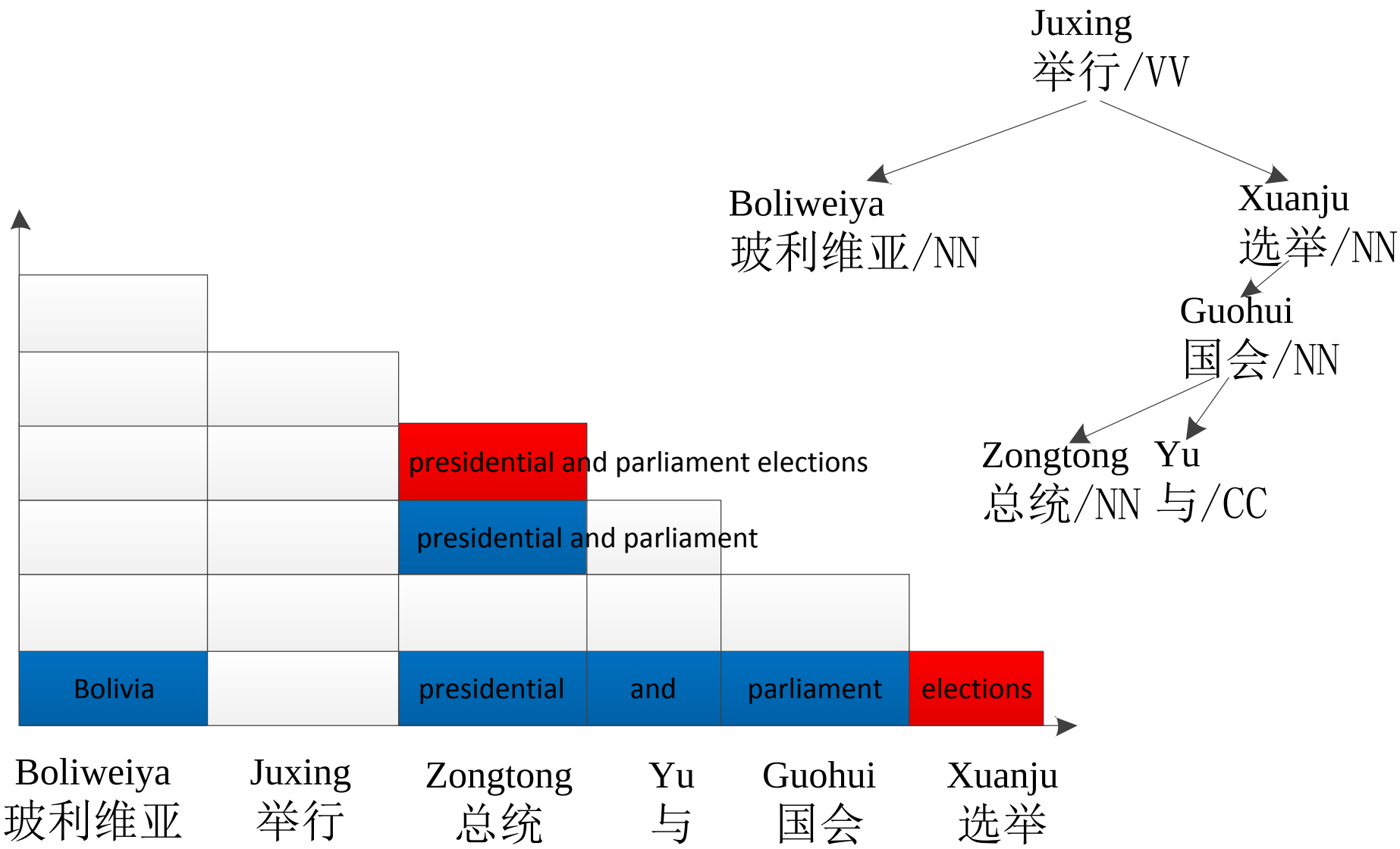

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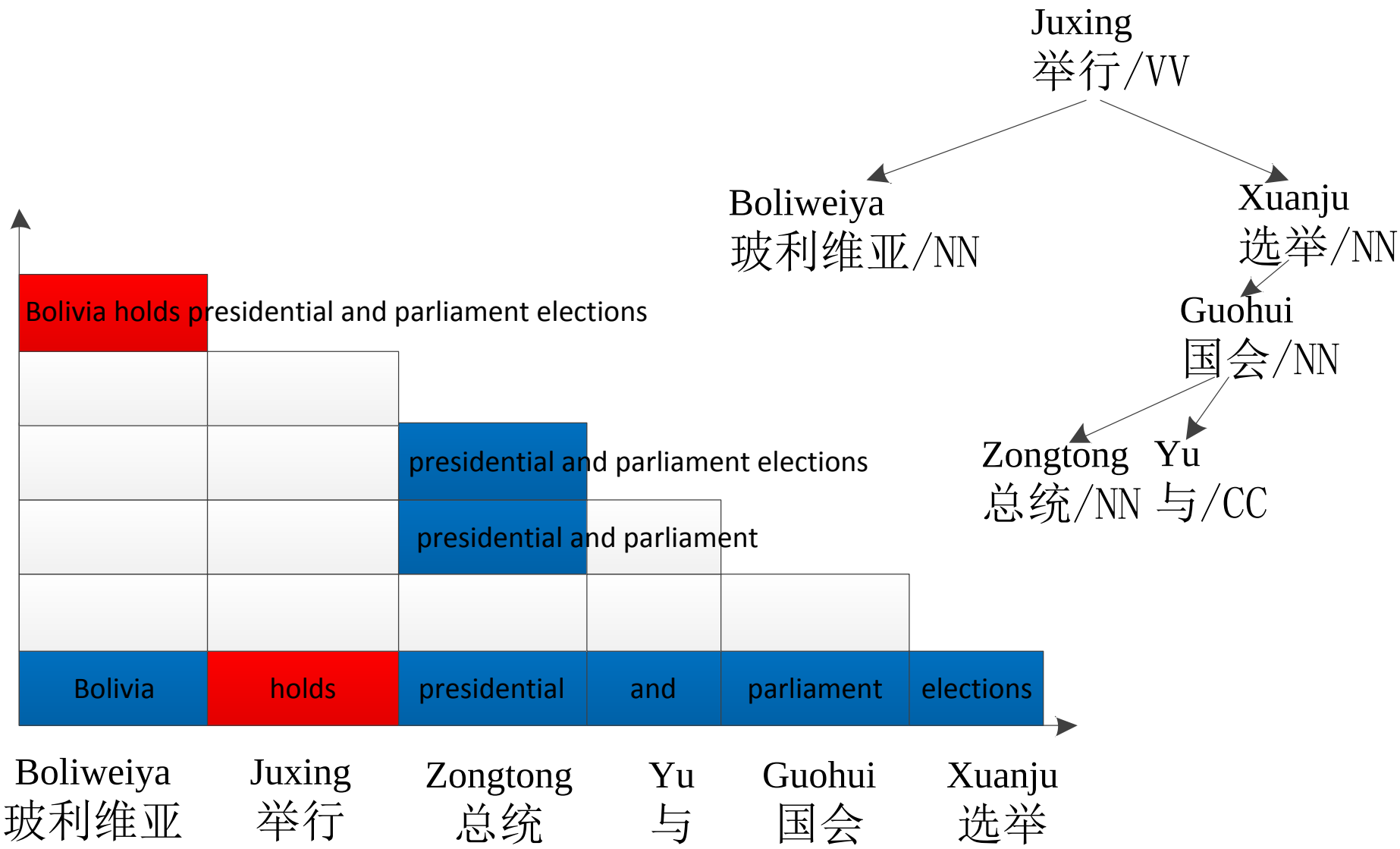

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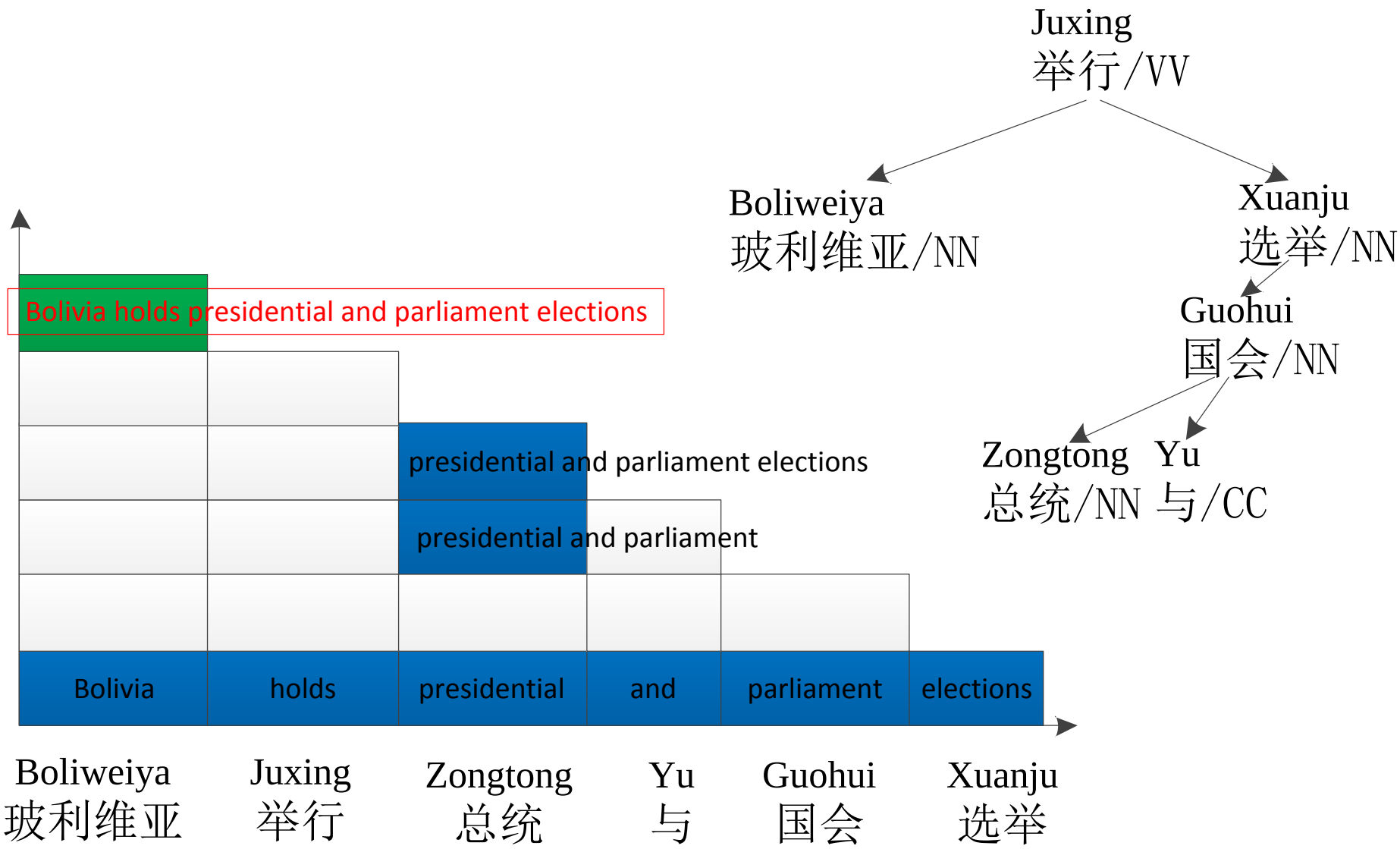
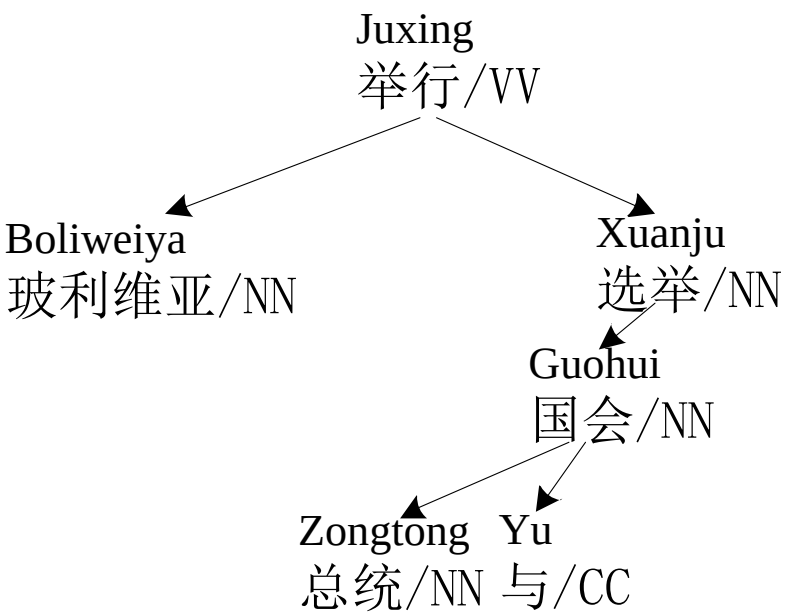


Transformation



Boliweiya	Juxing	Zongtong	Yu	Guohui	Xuanju
玻利维亚	举行	总统	与	国会	选举

Figure: An example of transforming a dependency tree into a constituent tree

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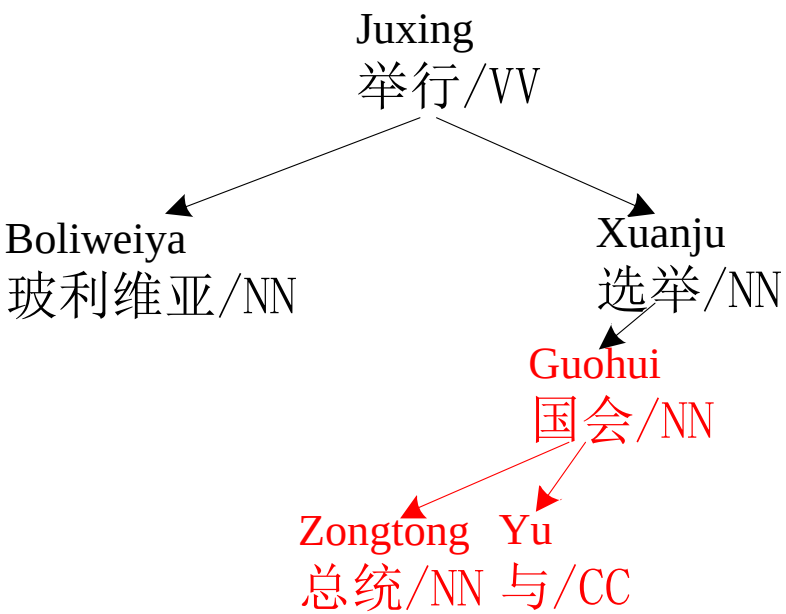

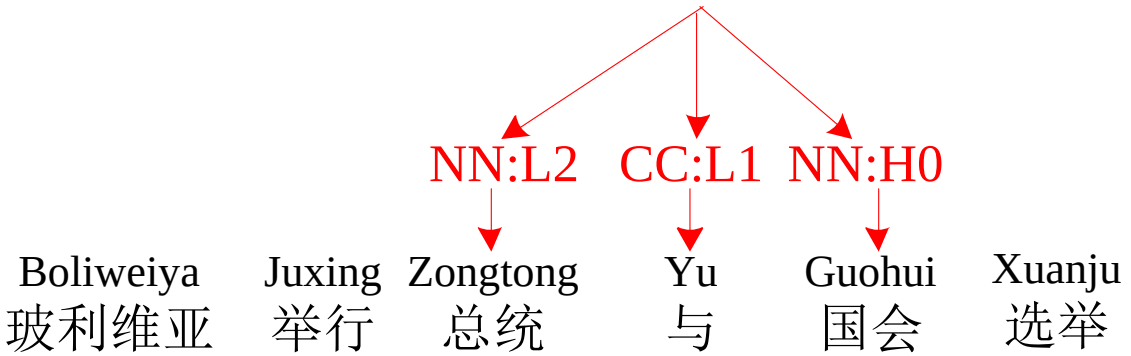

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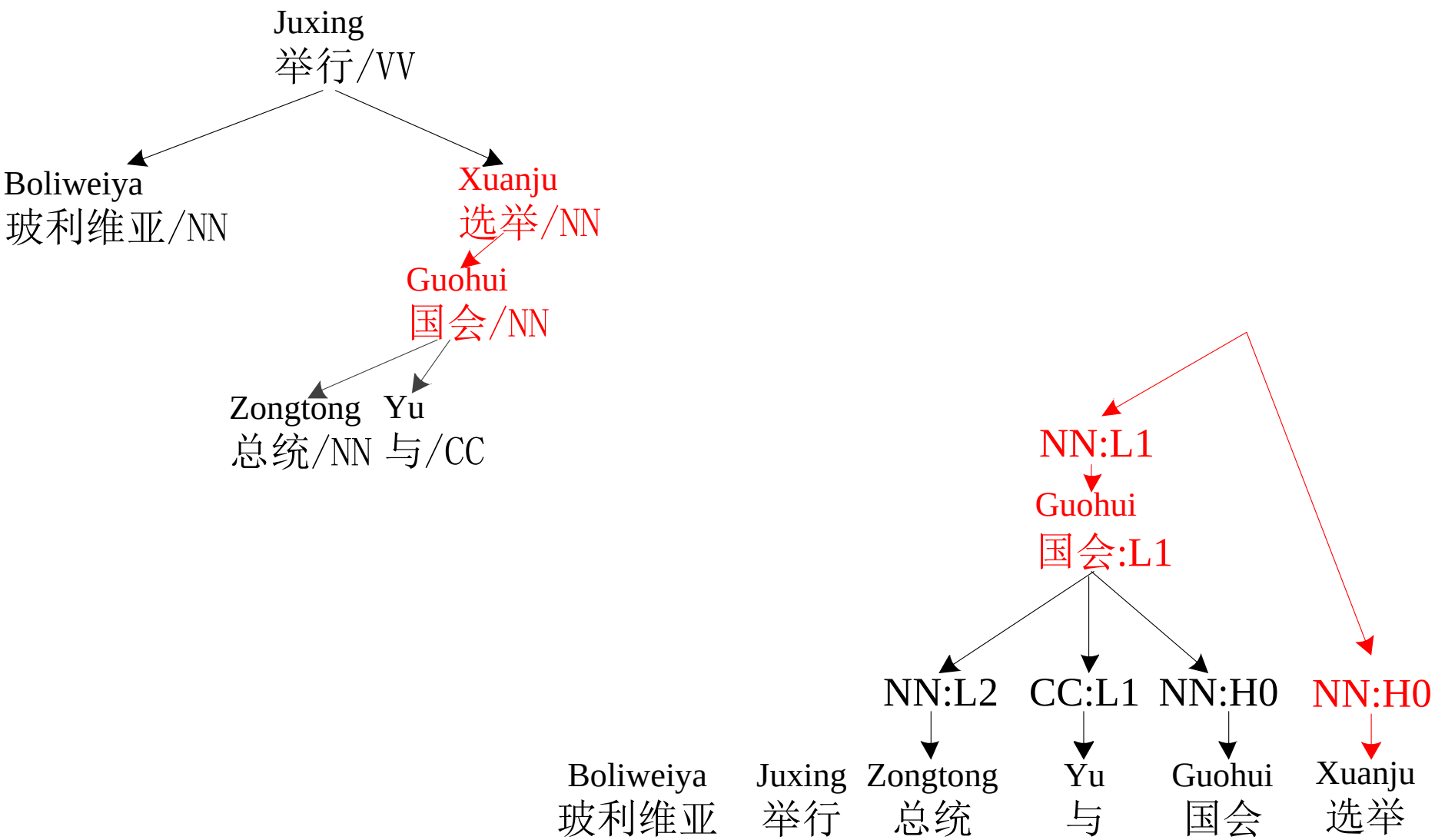

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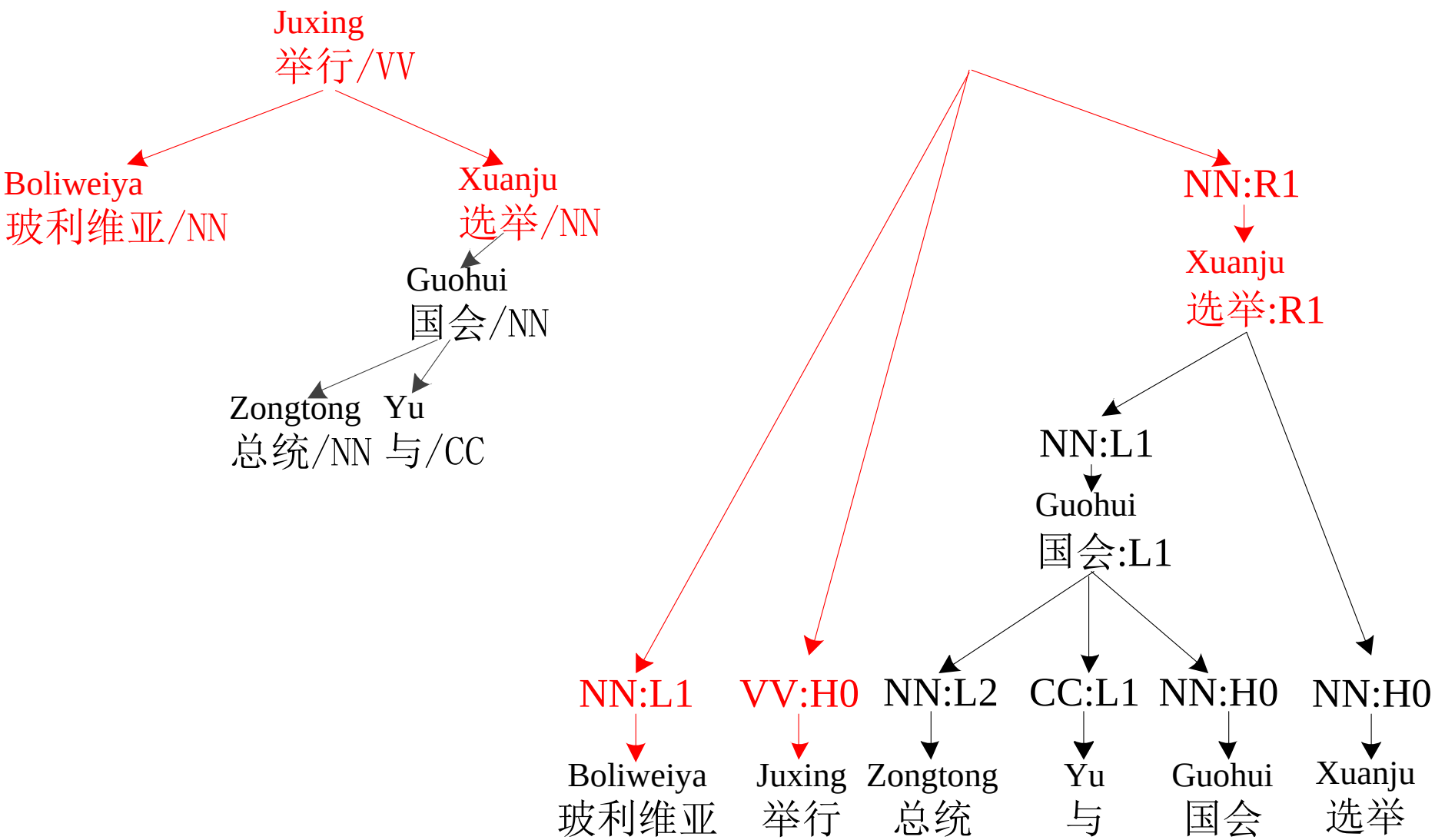

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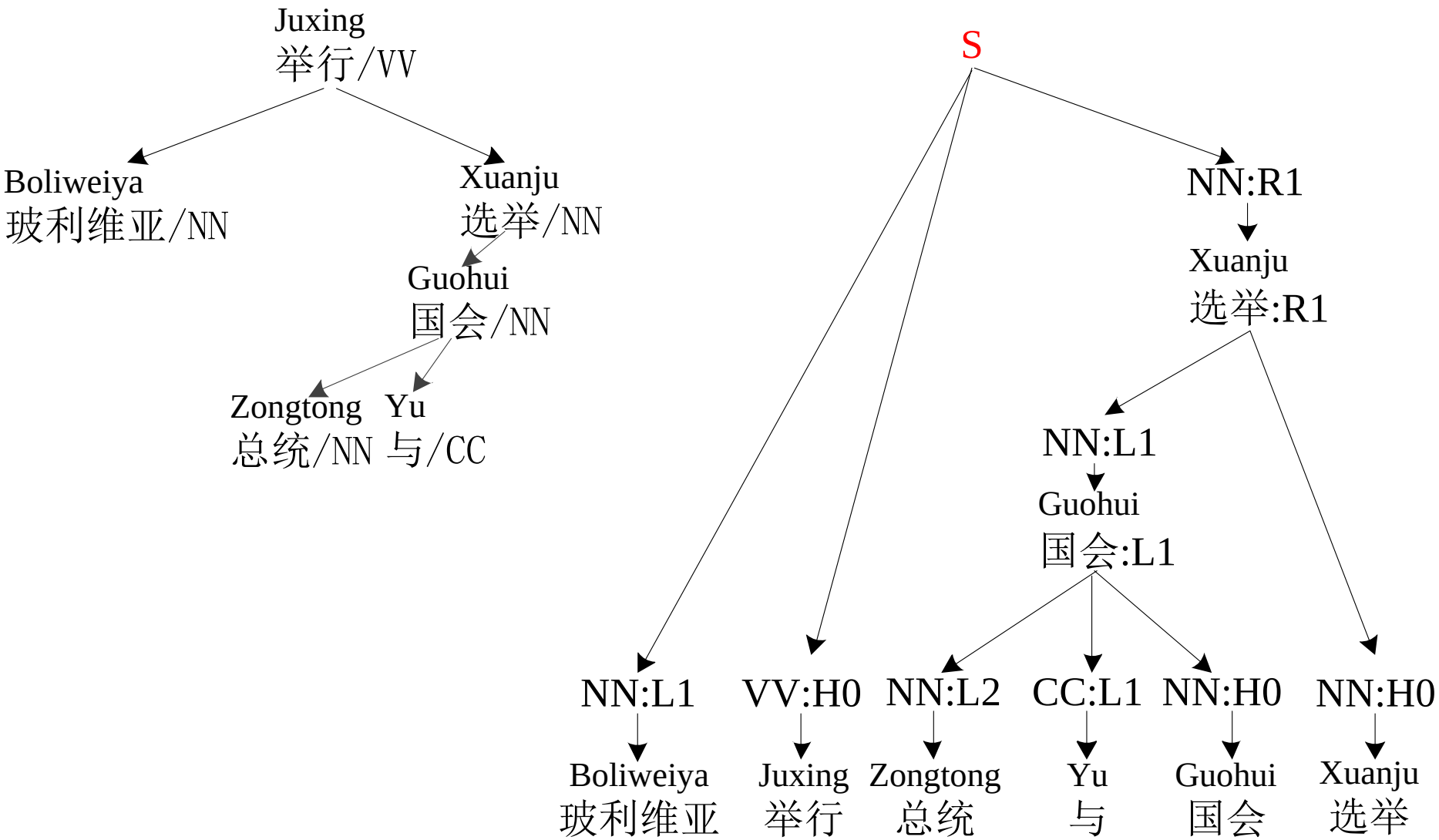

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Experiment

Systems	MT05
XJ	33.91
D2S	33.79

Table: BLEU score [%] of the Dep2Str model before (**XJ**) and after (**D2S**) dependency tree being transformed. Systems are trained on a selected 1.2M Chinese–English corpus.

Decomposition

Example

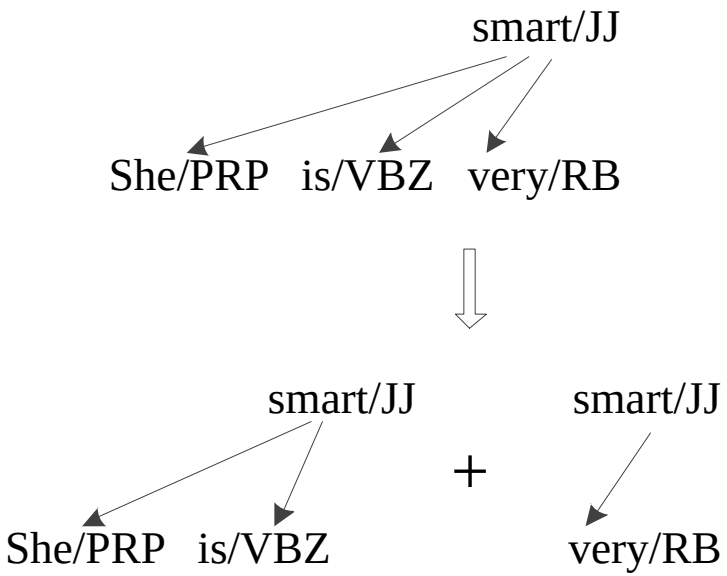


Figure: An example of decomposition on a head-dependent fragment.

Decomposition

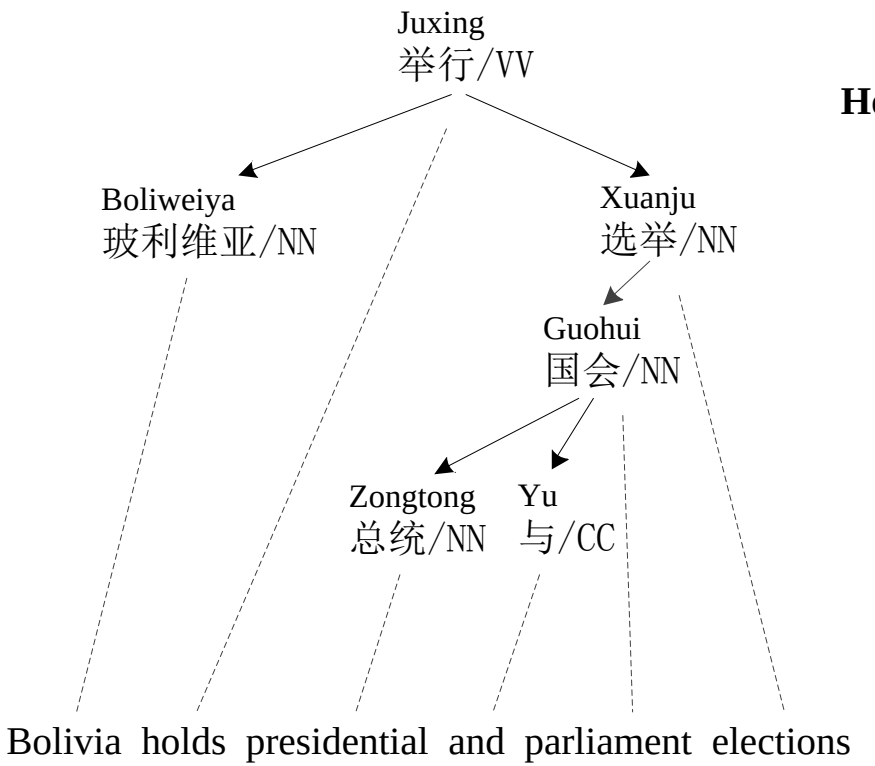
Formula

$$
\begin{aligned}
& L_i \cdots L_1 H R_1 \cdots R_j \\
& \qquad = L_m \cdots L_1 H R_1 \cdots R_n \\
& \qquad + L_i \cdots L_{m+1} H R_{n+1} \cdots R_j \\
& \text{subject to} \qquad (1) \\
& \qquad i \geq 0, j \geq 0 \\
& \qquad i \geq m \geq 0, j \geq n \geq 0 \\
& \qquad i + j > m + n > 0
\end{aligned}
$$

where H denotes the head node, L_i denotes the ith left dependent and R_j denotes the jth right dependent.

Decomposition

Training: Sub-structural Rules



Head Rules

Boliweiya
玻利维亚/NN ⇒ Bolivia ……

Head-Dependent Rules

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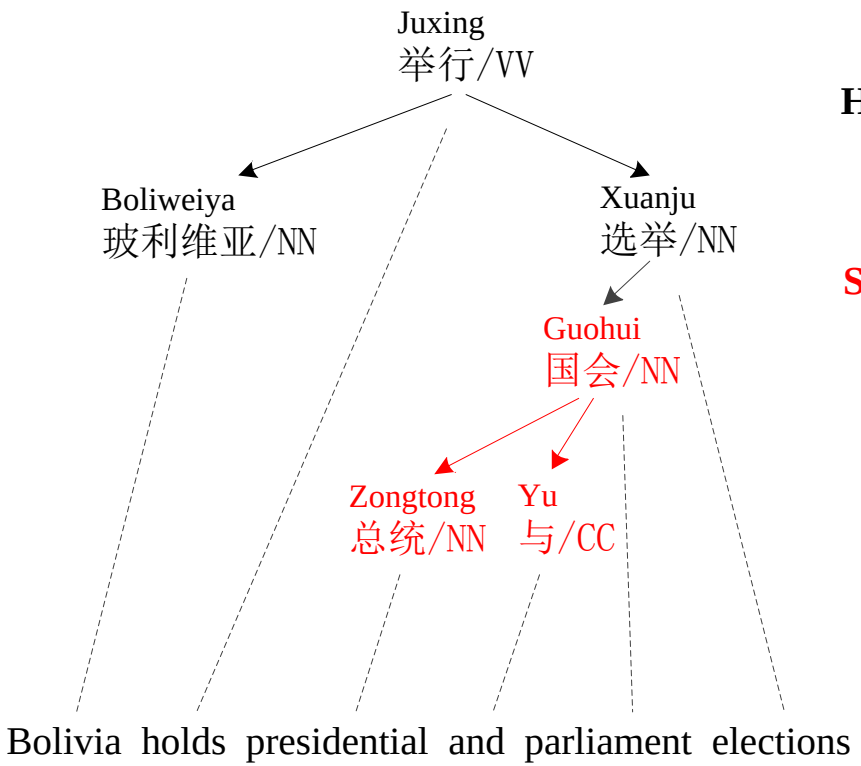
Figure: Extracting sub-structural rules

Decomposition

Training: Sub-structural Rules



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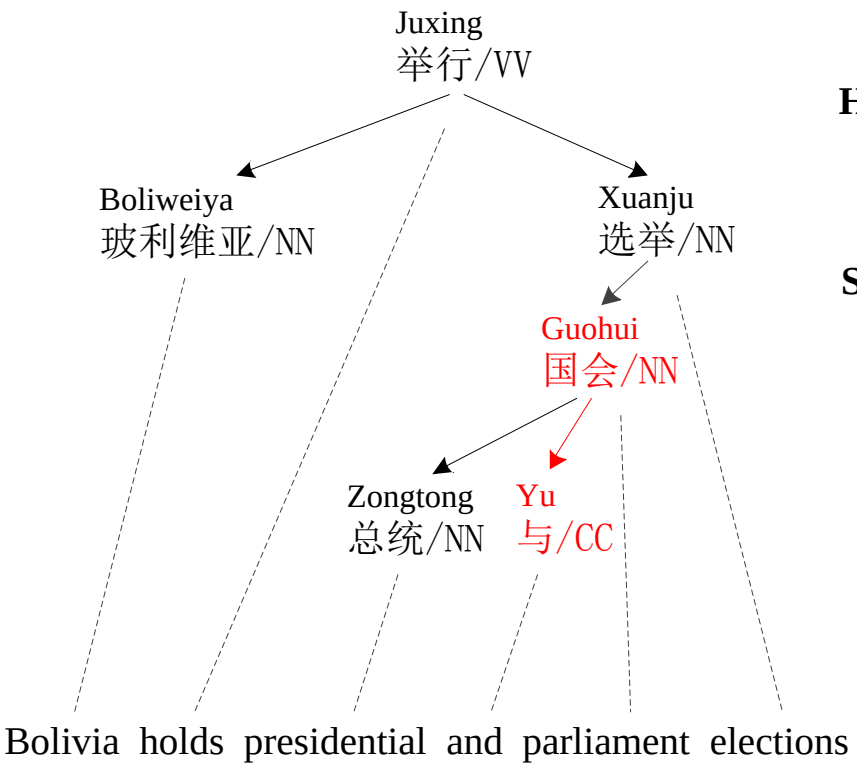

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Sub-structural Rules

Yu Guohui
(与) 国会 ⟹ and parliament

Guohui
(X1:CC) 国会 ⟹ X1 parliament

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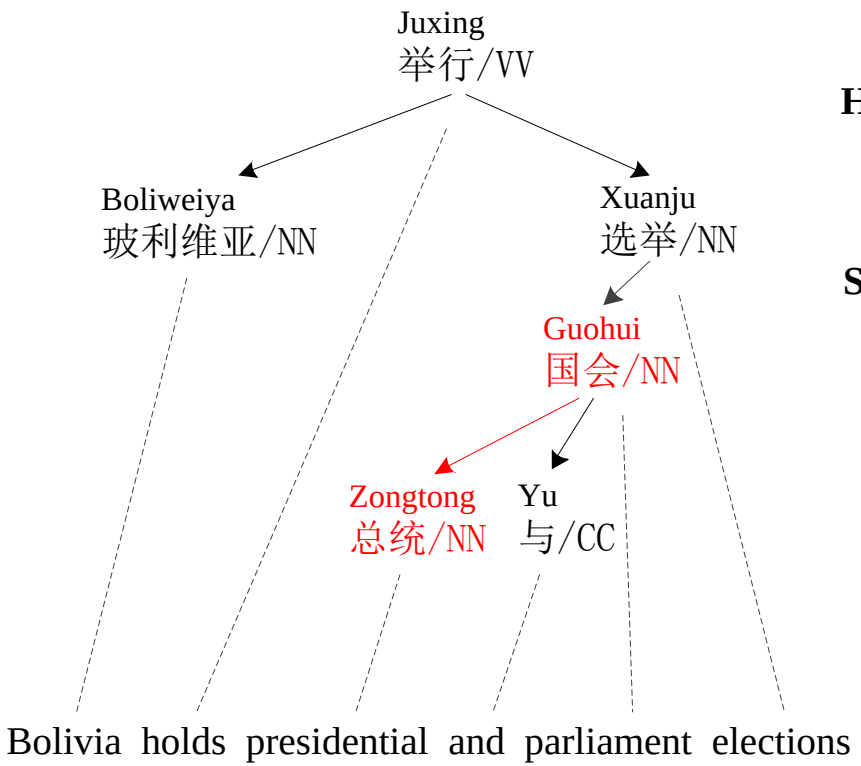

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Decoding: Pseudo Forest

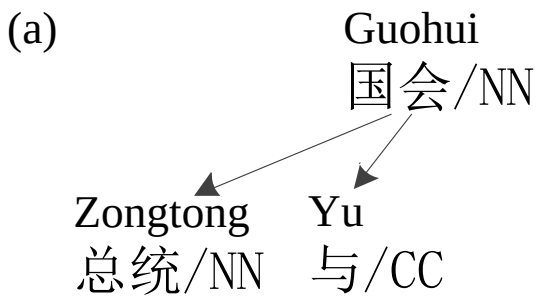

Figure: An example of translating a large HD fragment with the help of translations of its decomposed fragments

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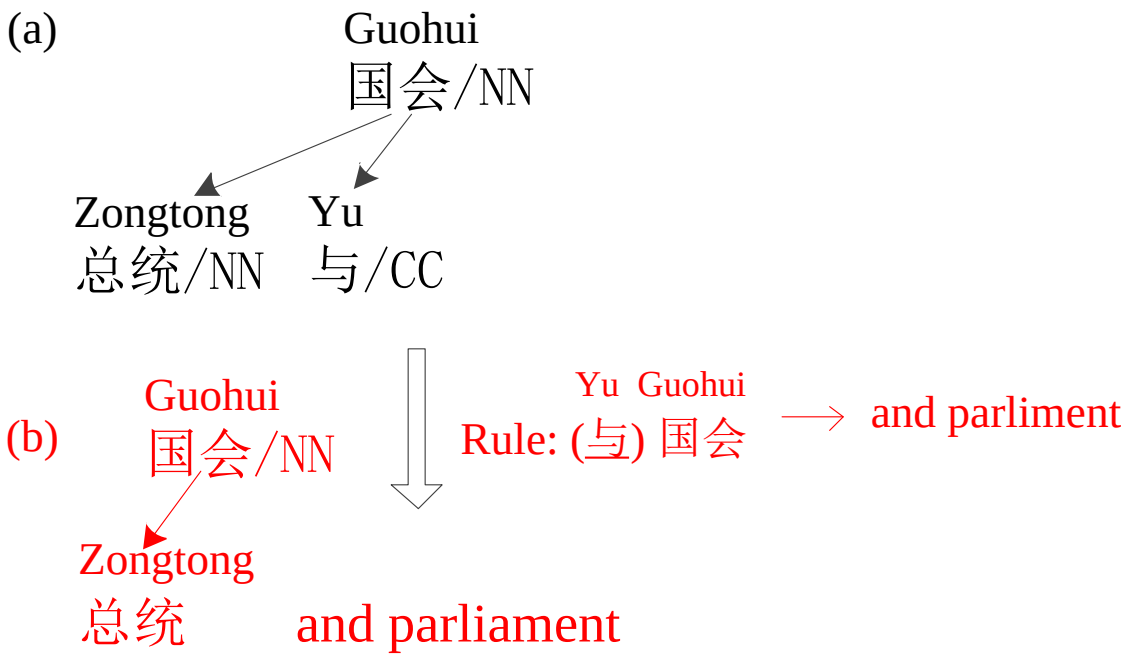

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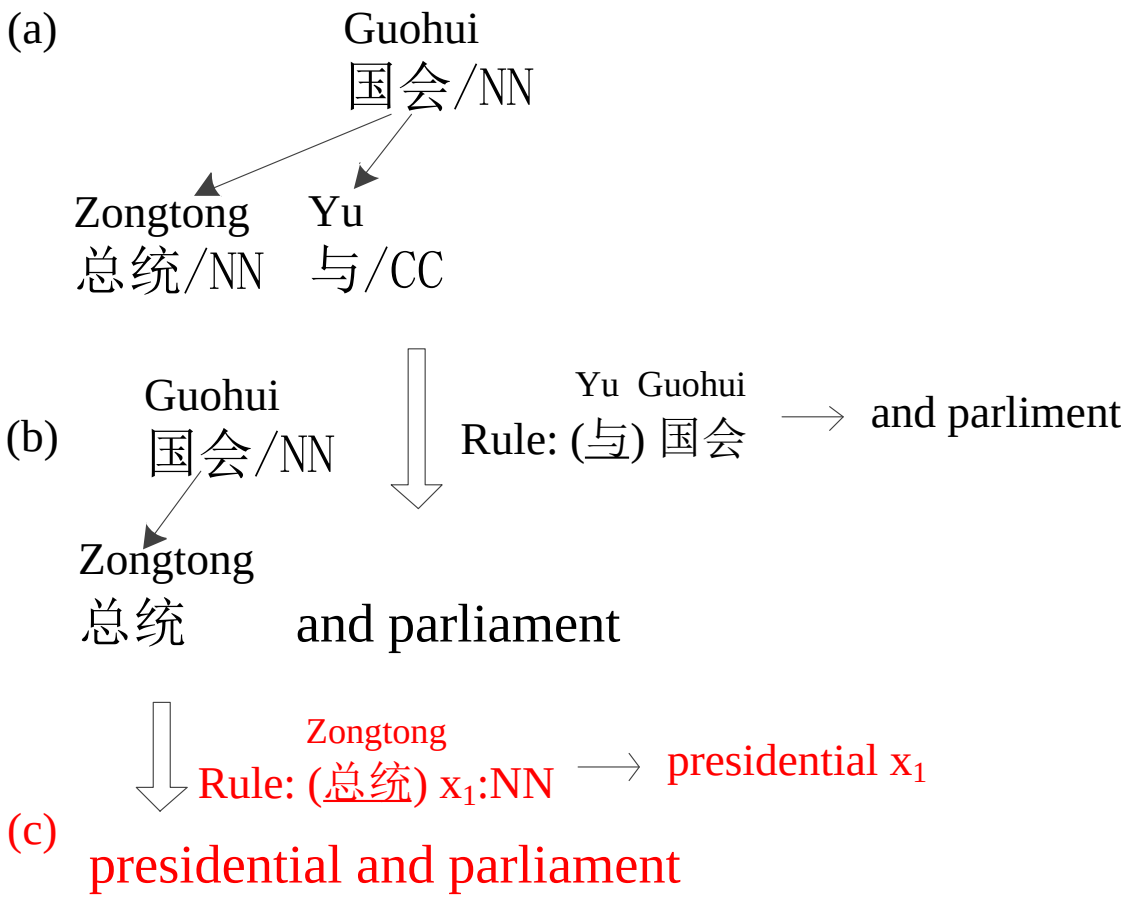

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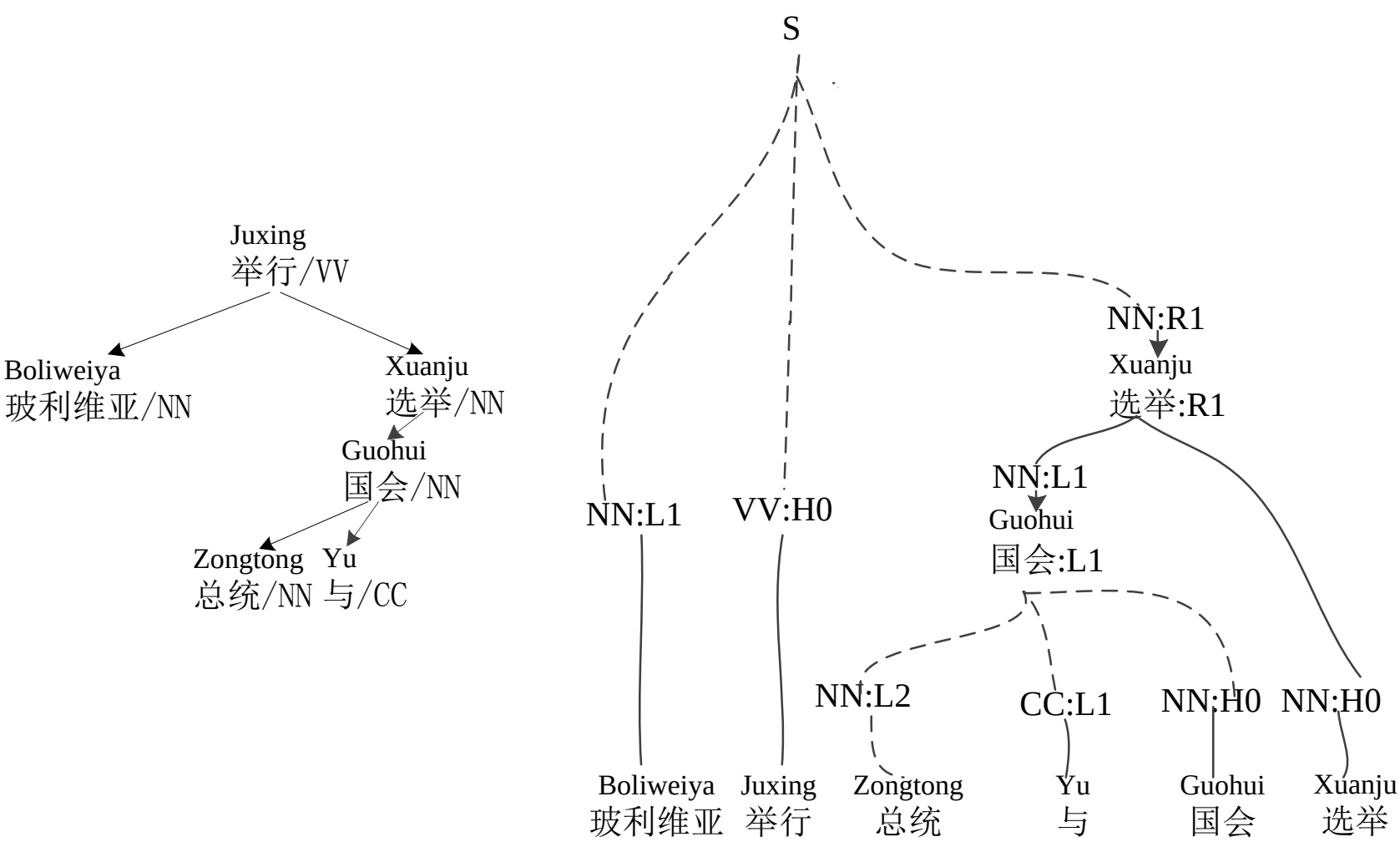

Figure: An example of creating pseudo-forest for a dependency tree.

Decomposition

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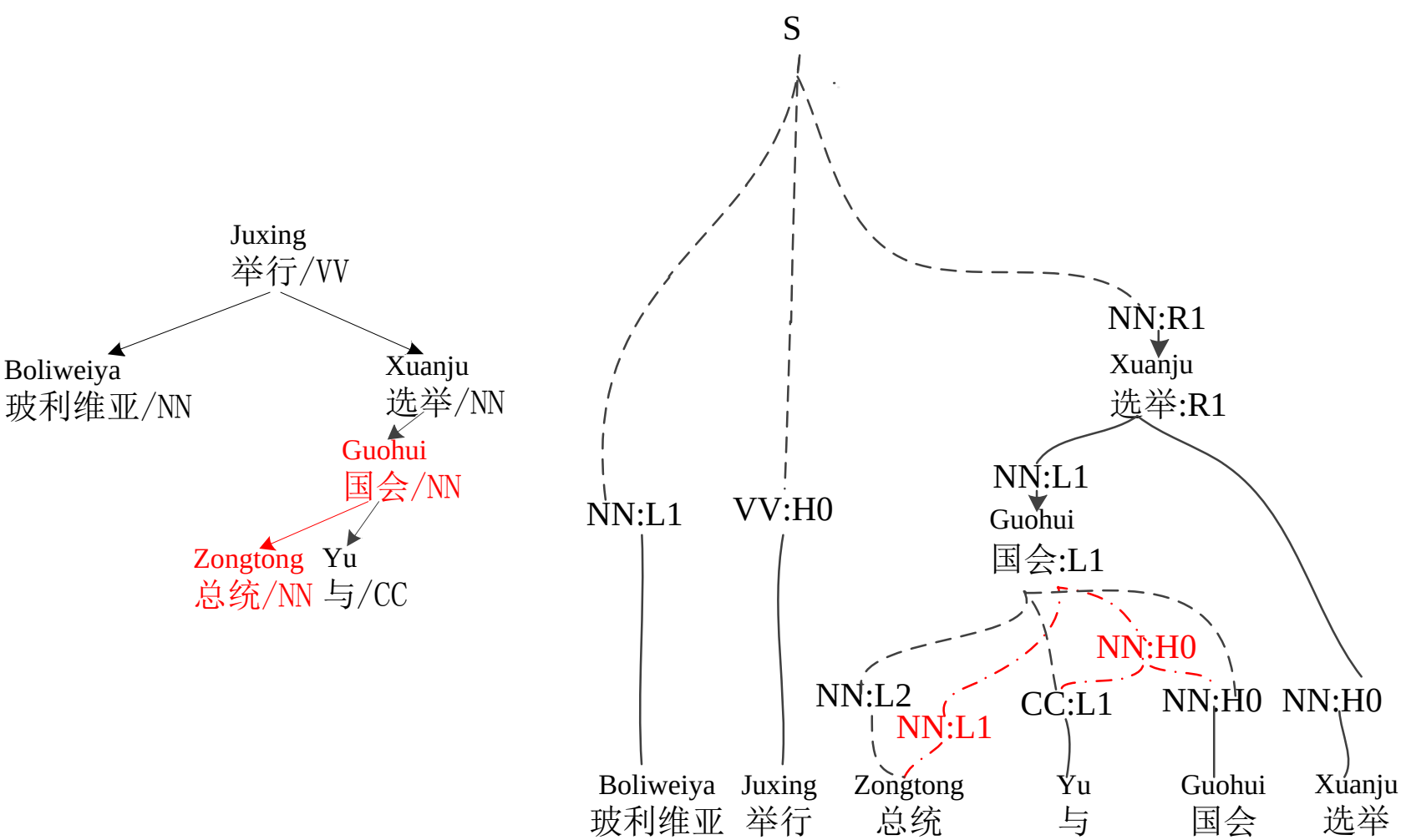

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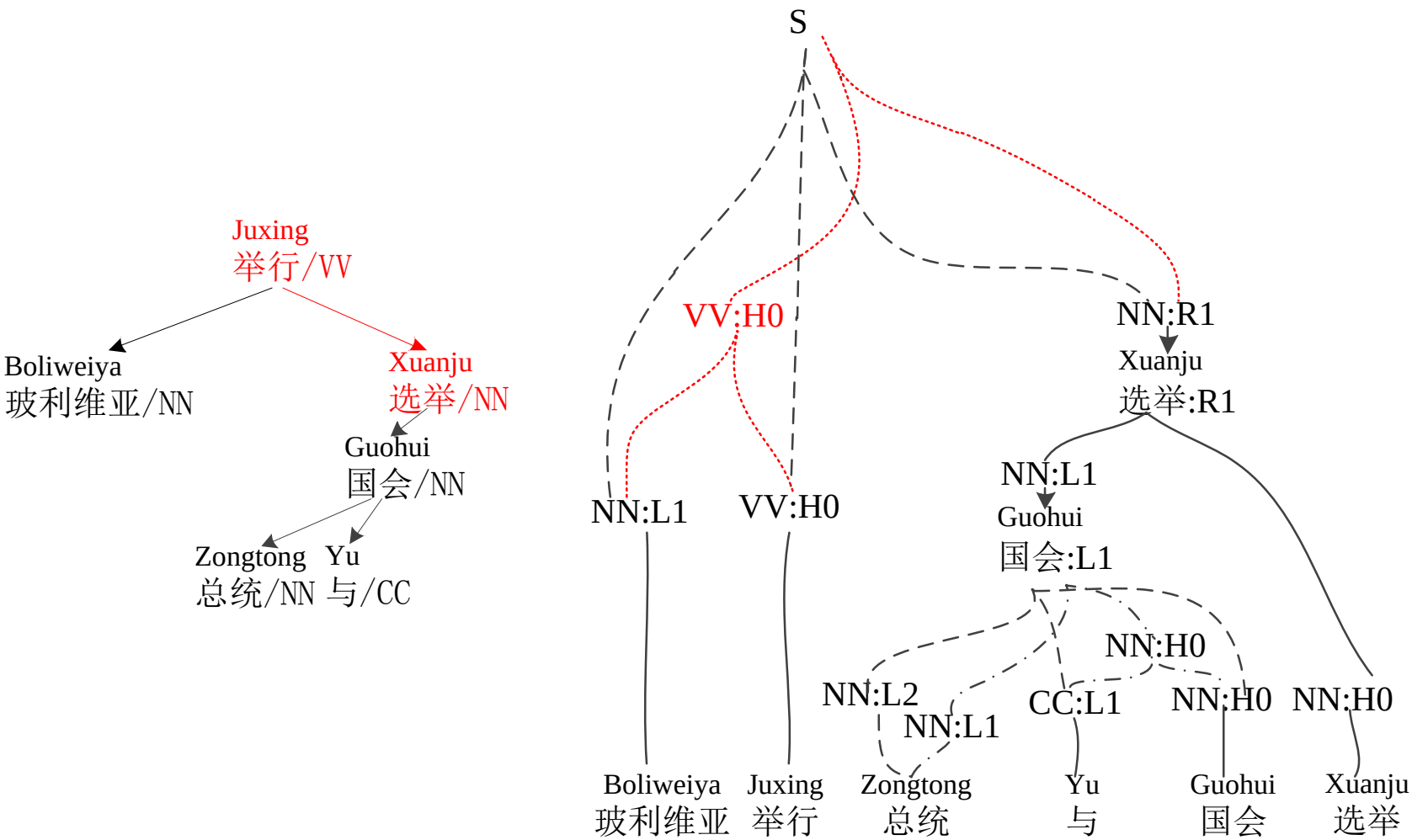

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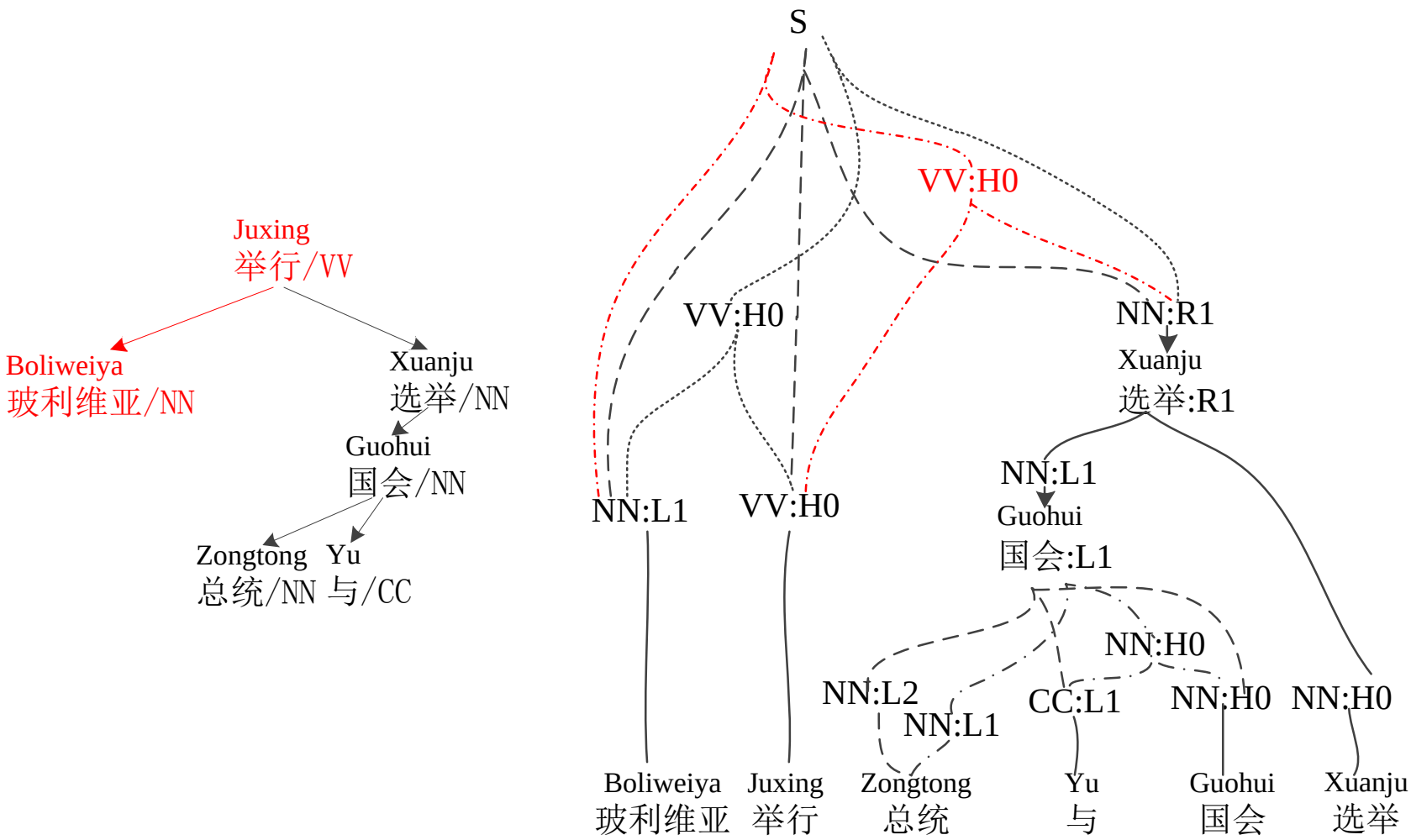

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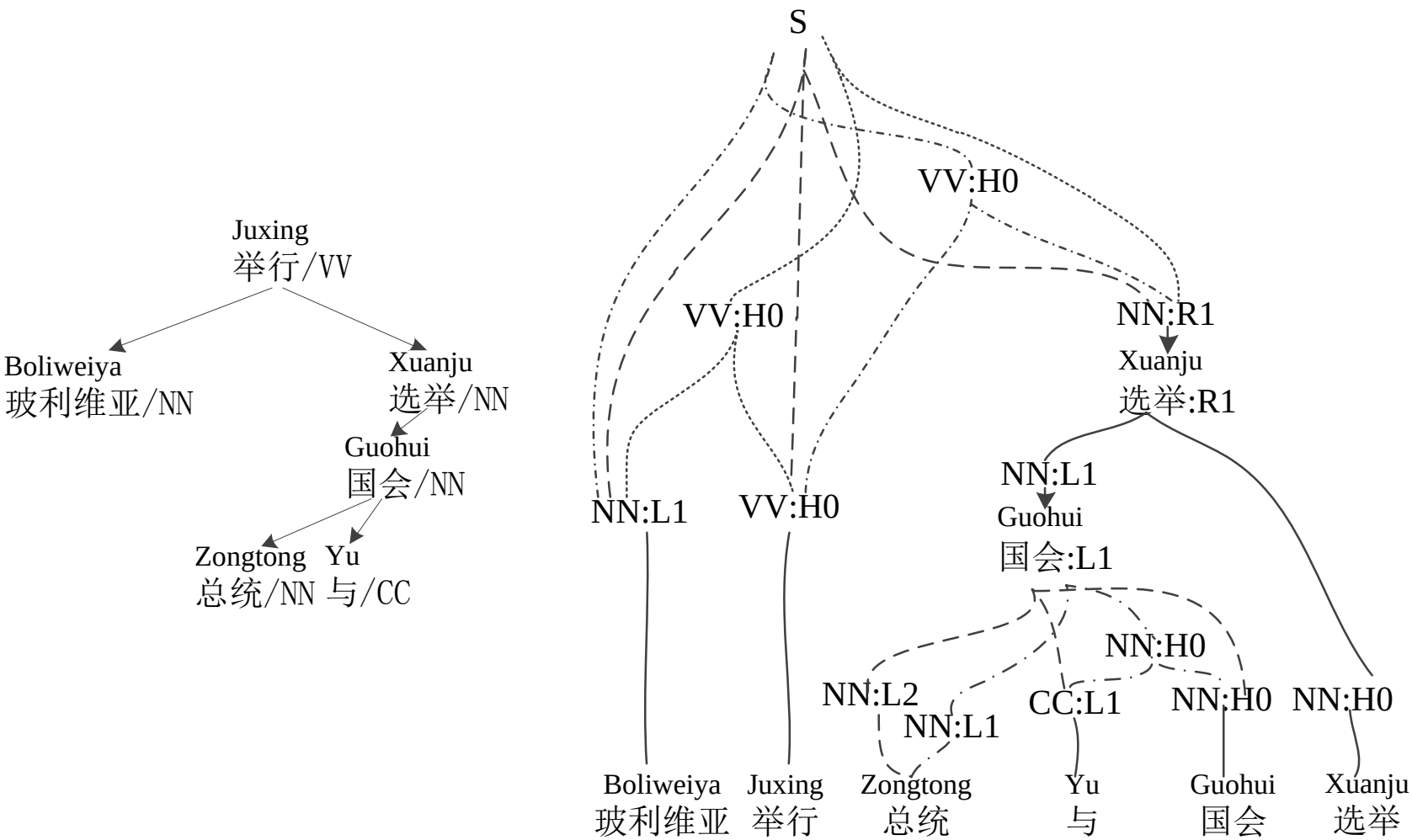

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Experiments

Systems	MT04	MT05
Moses HPB	35.56	33.99
D2S	33.93	32.56
+pseudo-forest	**34.28**	**34.10**
+sub-structural rules	**34.78**	**33.63**
+pseudo-forest	**35.46**	**34.13**
+phrase	**36.76***	**34.67***

Table: BLEU score [%] of our method and Moses HPB on the Chinese–English task.

Experiments

Systems	Test12	Test13
Moses HPB	20.44	22.77
D2S	20.05	22.13
+pseudo-forest	19.98	21.68
+sub-structural rules	**20.52**	**22.76**
+phrase	**20.91***	**23.46***
+pseudo-forest	20.25	22.24
+phrase	**20.75***	**23.20***

Table: BLEU score [%] of our method and Moses HPB on German–English task.

Experiments

Systems	# Rules	
	CE task	DE task
Moses HPB	388M	684M
D2S	27M	41M
+sub-structural rules	116M	121M
+phrase	215M	274M

Table: The number of rules in different systems On the Chinese–English (CE) and German–English (DE) corpus. Note that pseudo-forest (not listed) does not influence the number of rules.

Conclusion

- implement the Dep2Str model without changing the decoder in Moses
- improve this model to be comparable with Moses HPB
- with resort to phase rule, this model is significantly better than Moses HPB

Download

This implementation is available at
`http://computing.dcu.ie/~liangyouli/dep2str.zip`

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The End
Thanks for Your Attention