Chinese Parsing Exploiting Characters

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Traditional: Word-based Chinese Parsing

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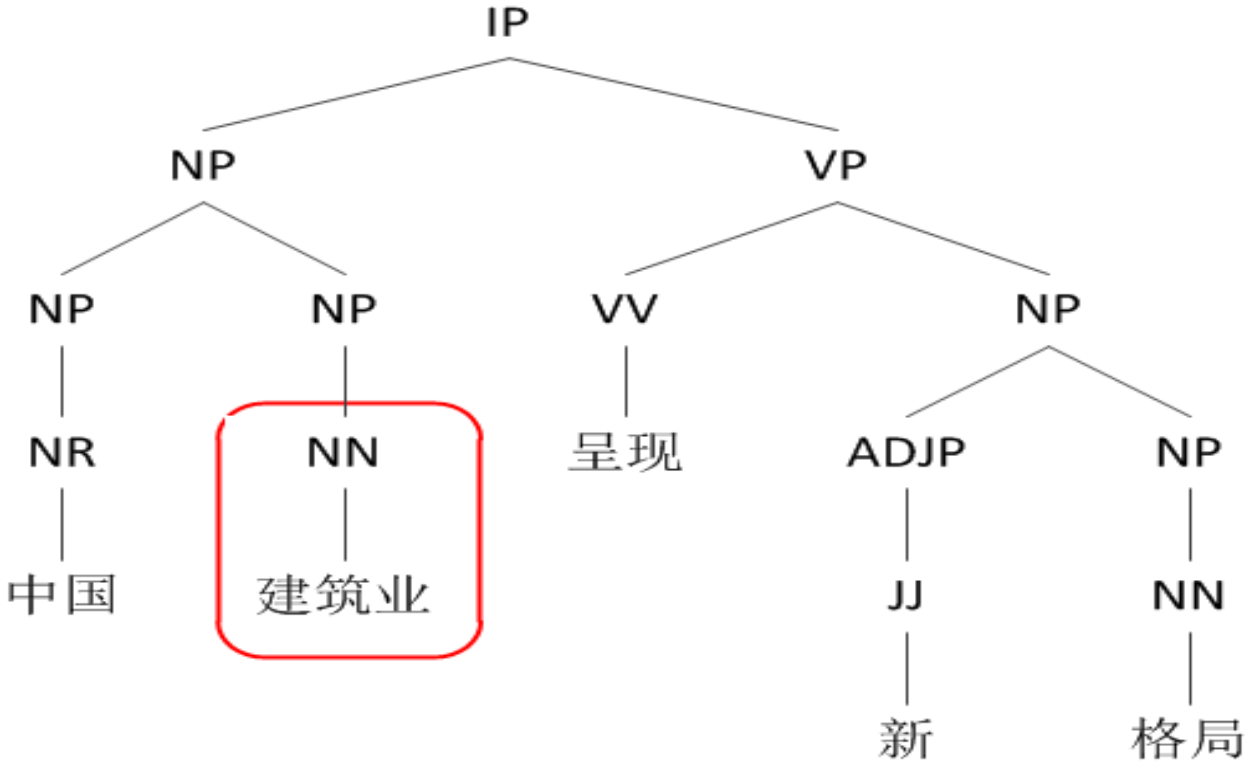

CTB-style word-based syntax tree for “中国 (China) 建筑业 (architecture industry) 呈现 (show) 新 (new) 格局 (pattern)”.

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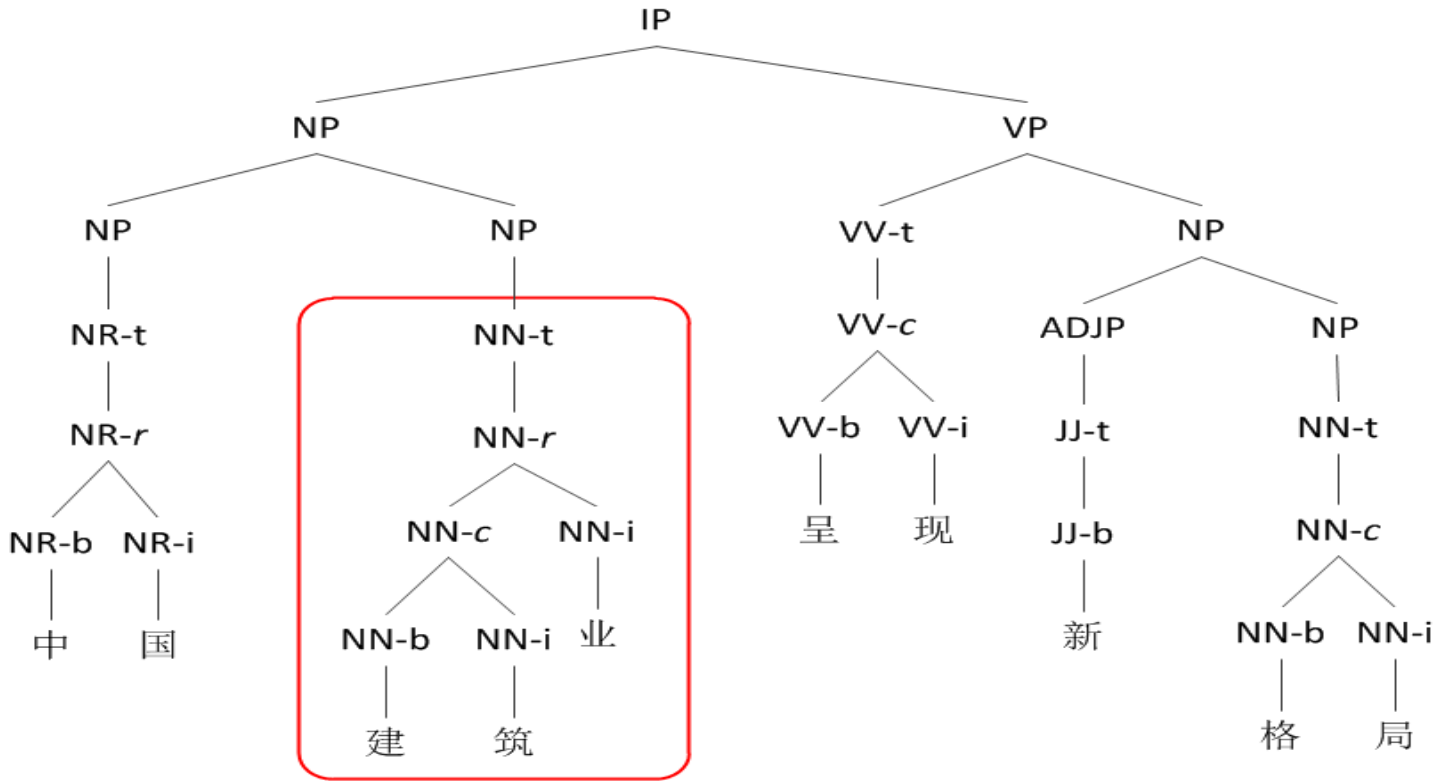

Character-level syntax tree with hierarchal word structures for “中 (middle) 国 (nation) 建 (construction) 筑 (building) 业 (industry) 呈 (present) 现 (show) 新 (new) 格 (style) 局 (situation)”.

Why Character-based ?

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- Chinese words have syntactic structures.

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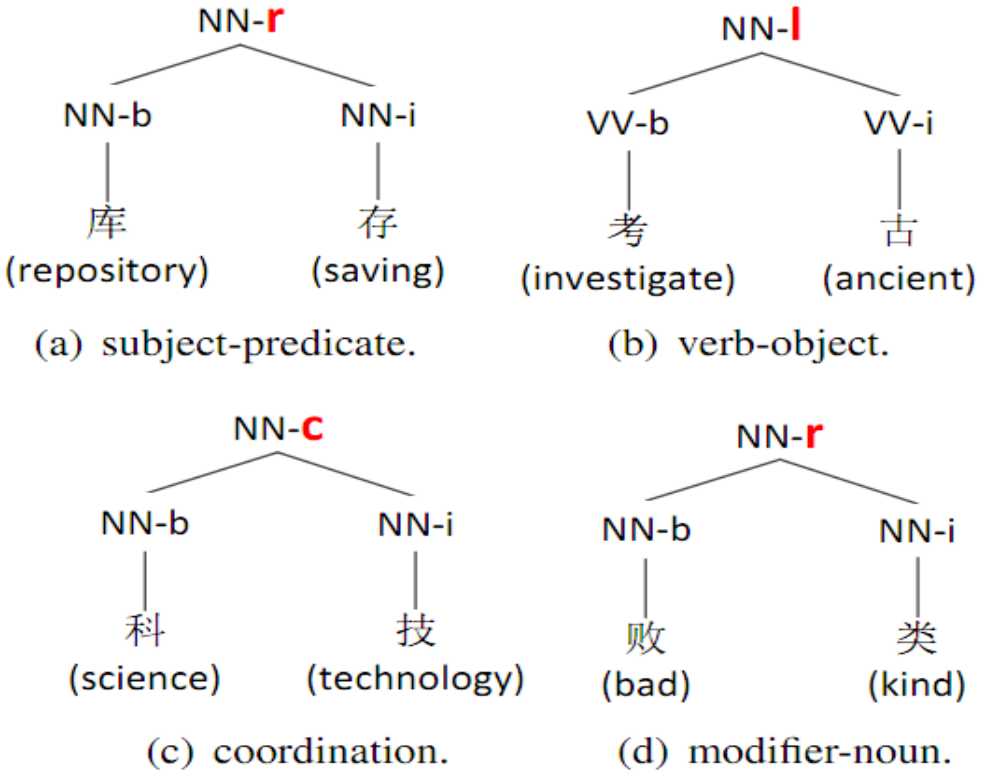

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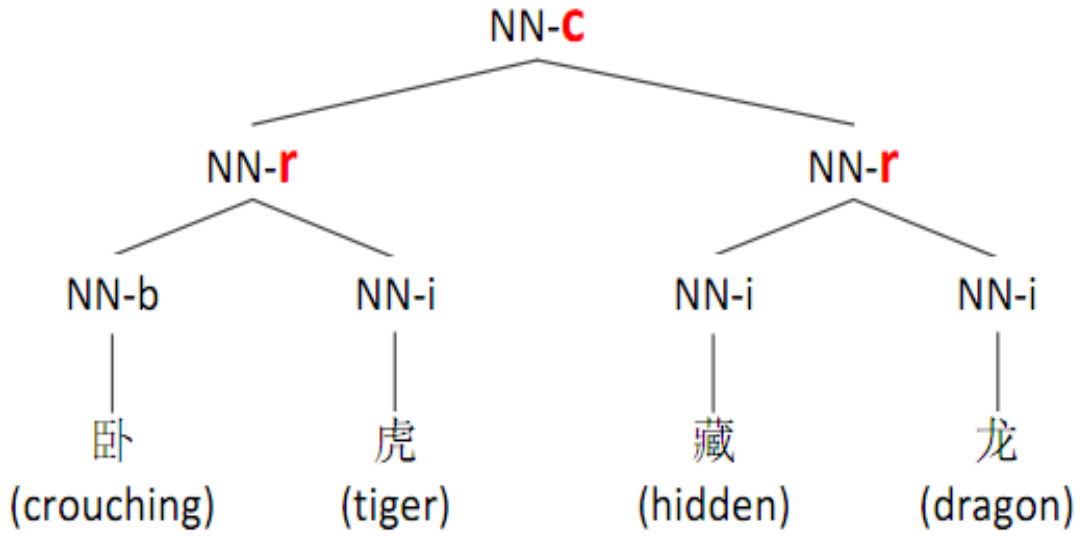

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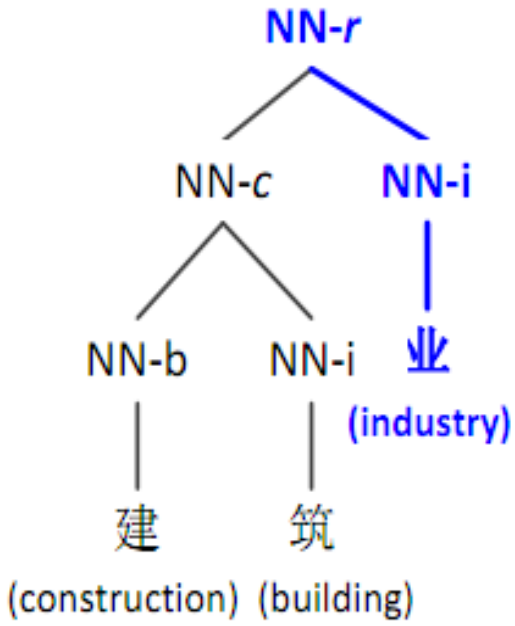

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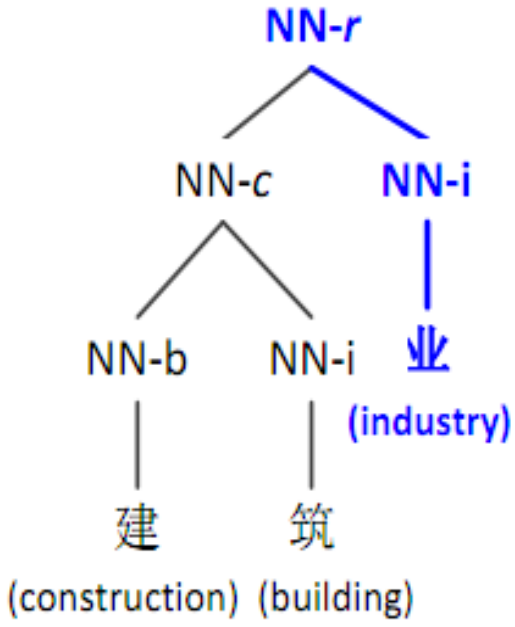

Representing the whole word by a character, which is less sparse.

Why Character-based ?

- Build syntax tree from character sequences.
  - Not require segmentation or POS-tagging as input.
  - Benefit from joint framework, avoid error propagation.

Word Structure Annotation

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- Binarized tree structure for each word.

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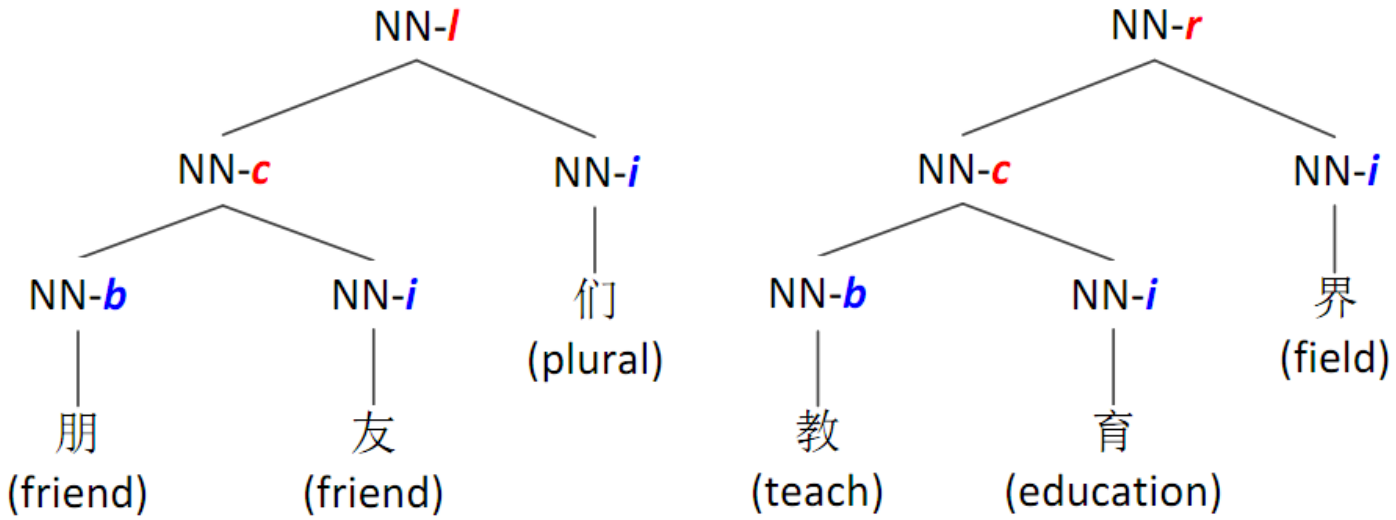

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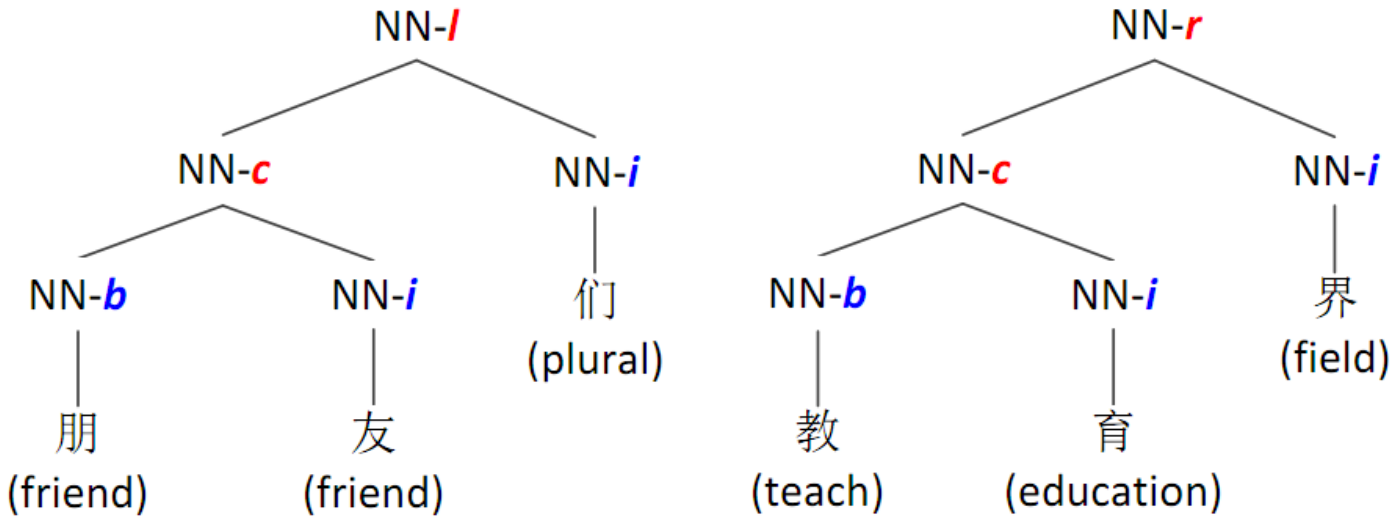

- **b, i denote whether the below character is at a word's beginning position.**
- **l, r, c denote the head direction of current node, respectively left, right and coordination.**

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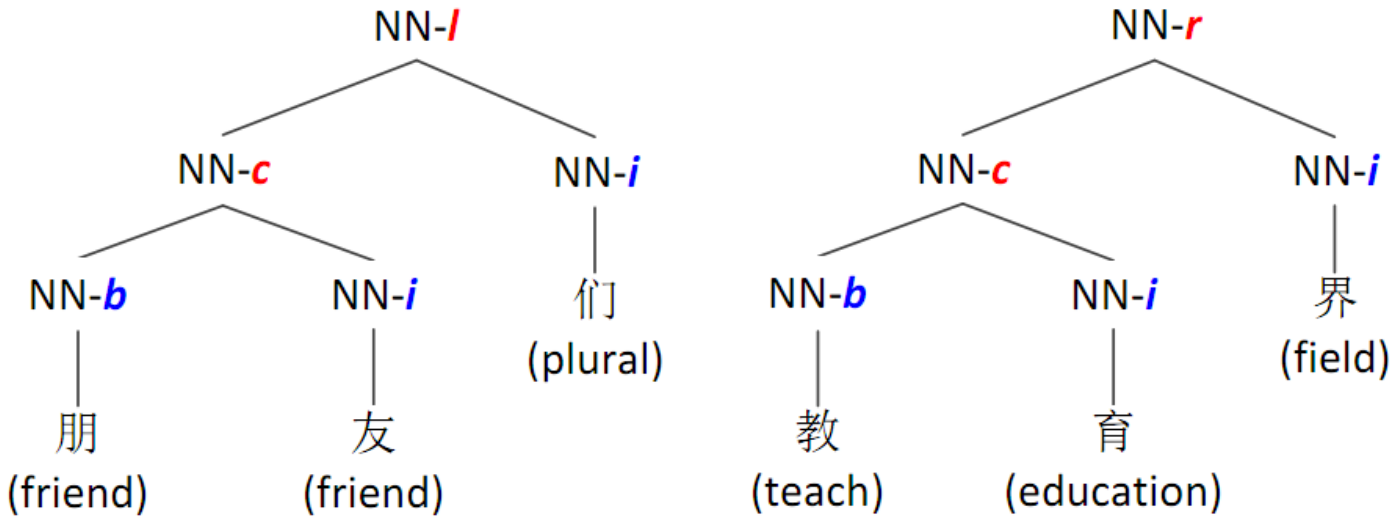

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We extend word-based phrase-structures into character-based syntax trees using the word structures demonstrated above.

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- Annotation input: a word and its POS.

  A word may have different structures according to different POS.

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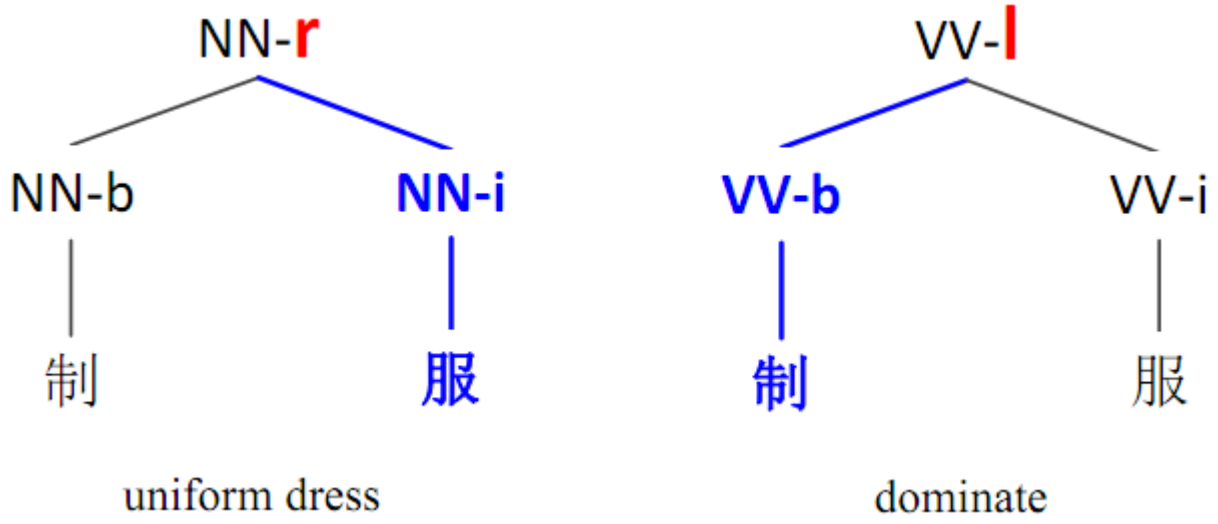

Outline

- Our Chinese Parsing Model
- Experiments
- Conclusion

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The Character-based Parser

- A Transition-based Parser using Beam-search Decoding Algorithm.
  - Extended from Zhang and Clark (2009), a word-based transition parser.
- Incorporating features of a word-based parser as well as a joint SEG&POS system.
- Adding the deep character information from word structures.

The Transition System

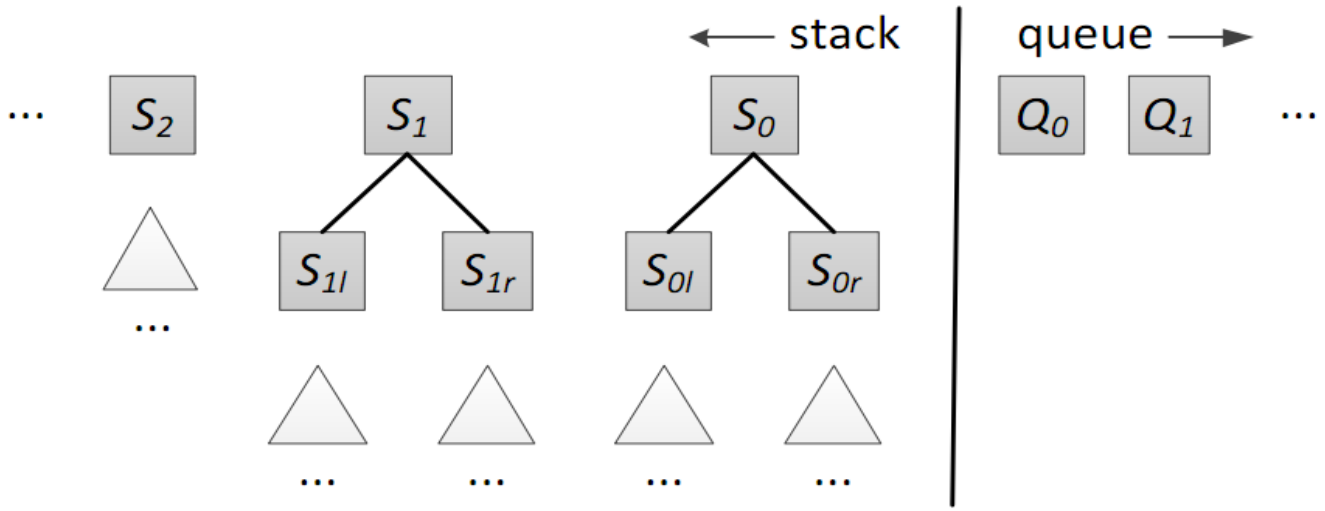
The Transition System

- State

- Actions:

The Transition System

- State



- Actions:

The Transition System

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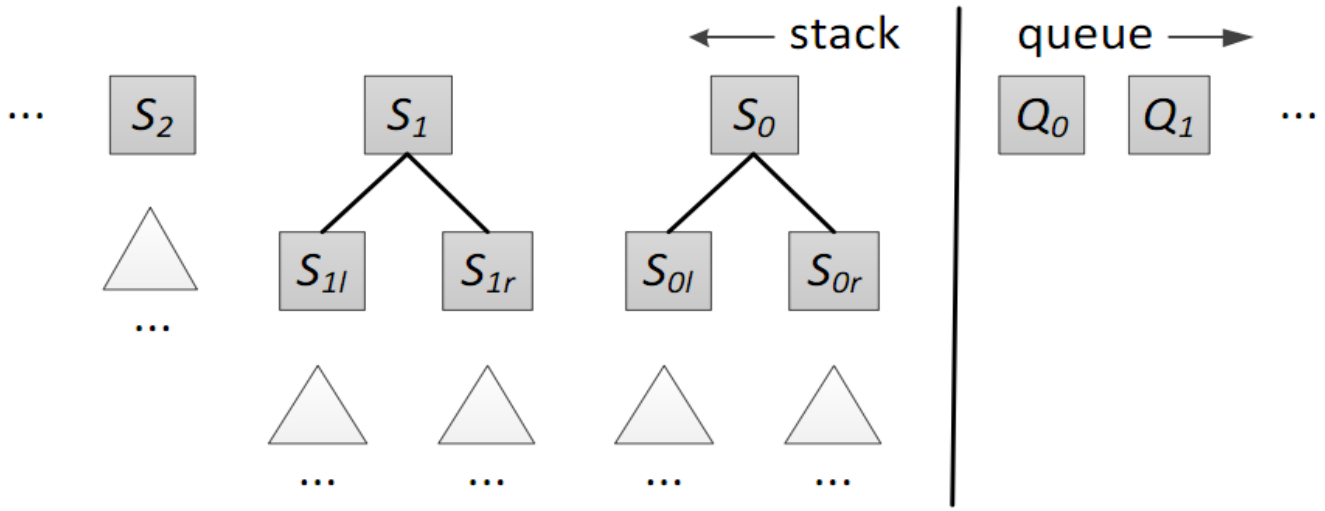


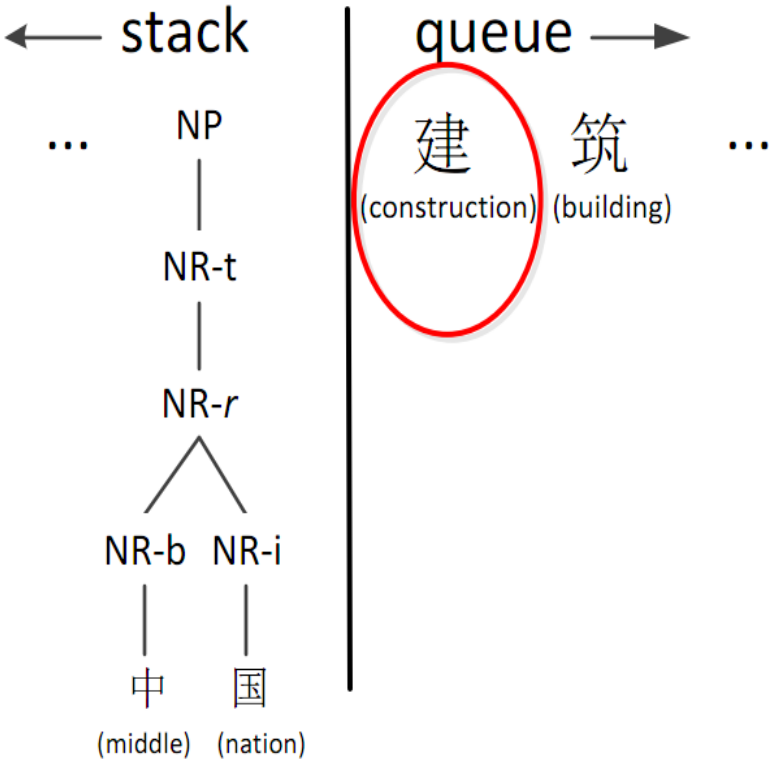
- Actions:
  - SHIFT-SEPARATE(*t*), SHIFT-APPEND, REDUCE-SUBWORD(*d*), REDUCE-WORD, REDUCE-BINARY(*d;l*), REDUCE-UNARY(*l*), TERMINATE

Transition Actions

- SHIFT-SEPARATE(*t*)

Transition Actions

- SHIFT-SEPARATE(*t*)



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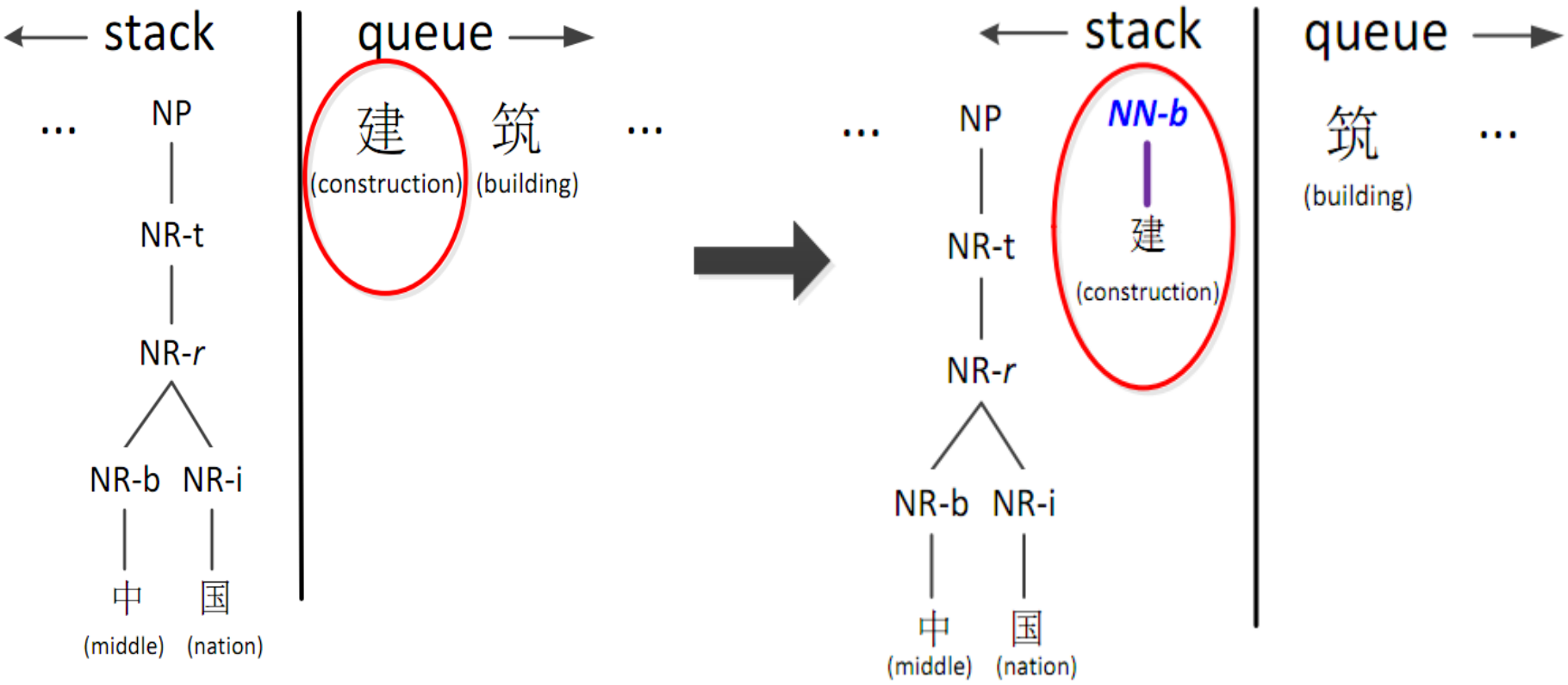

Transition Actions

- SHIFT-APPEND

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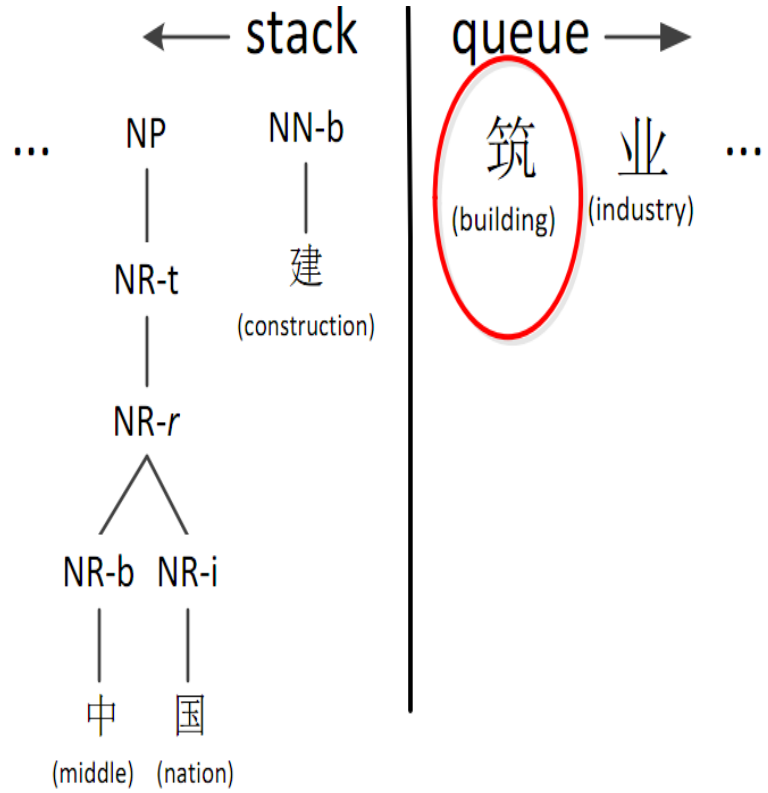

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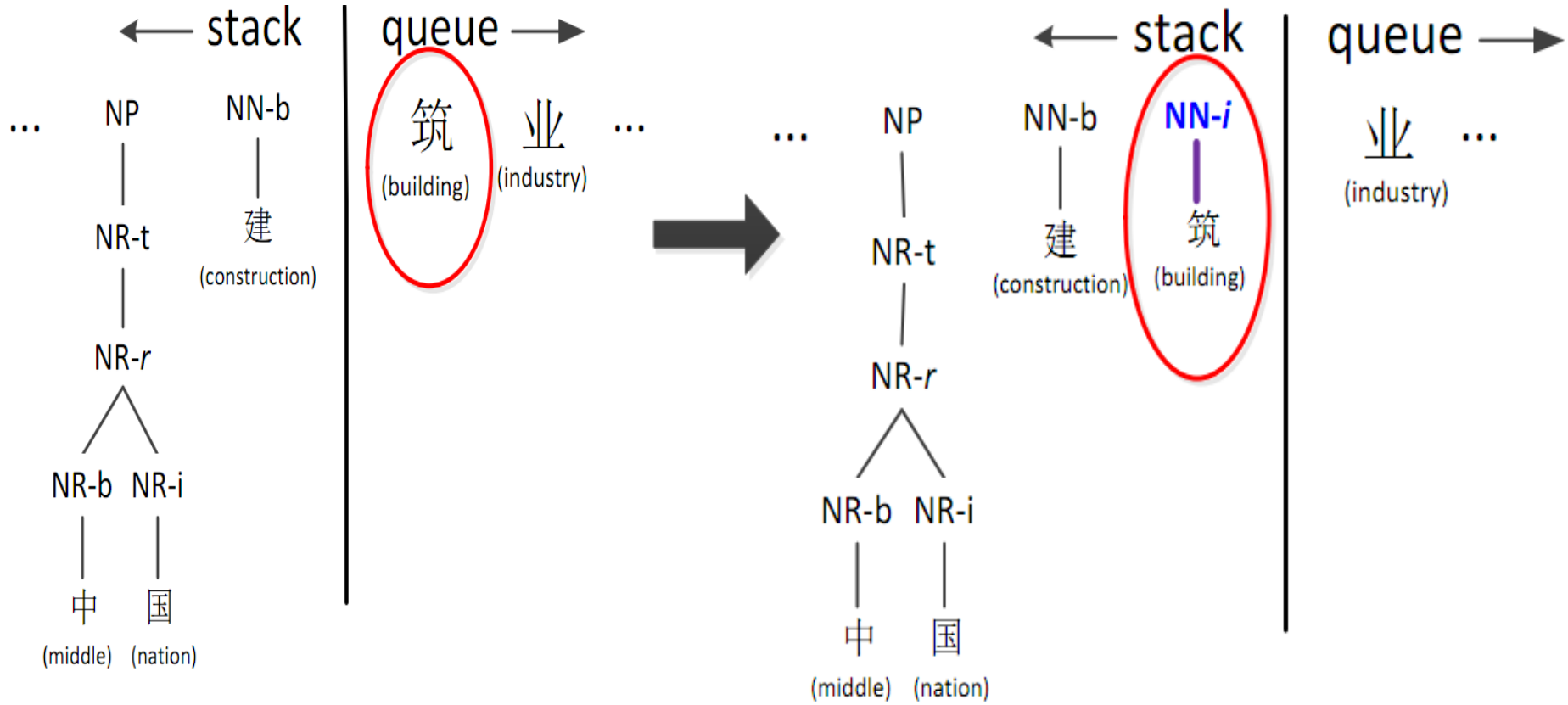

Transition Actions

- REDUCE-SUBWORD(***d***)

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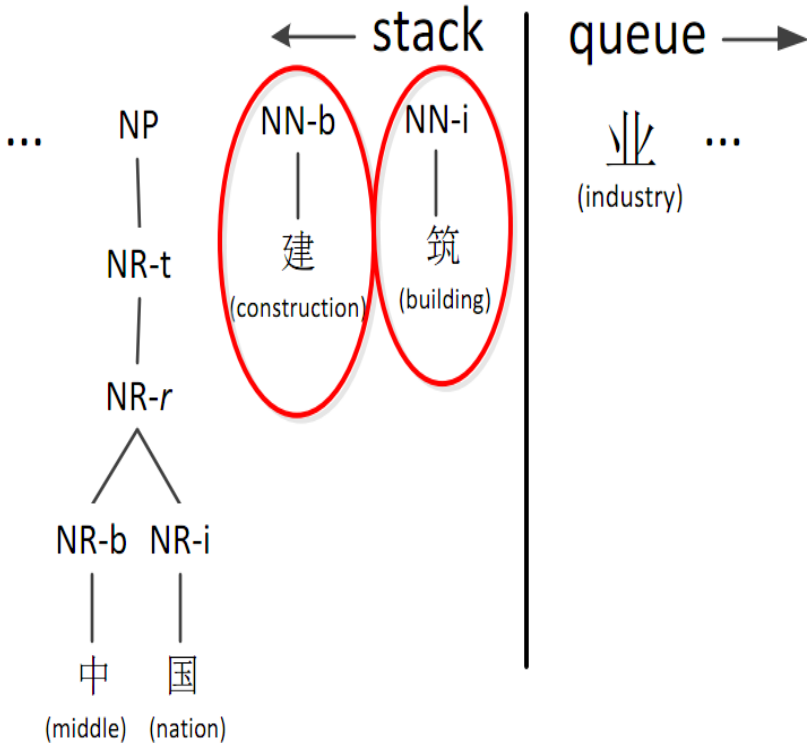

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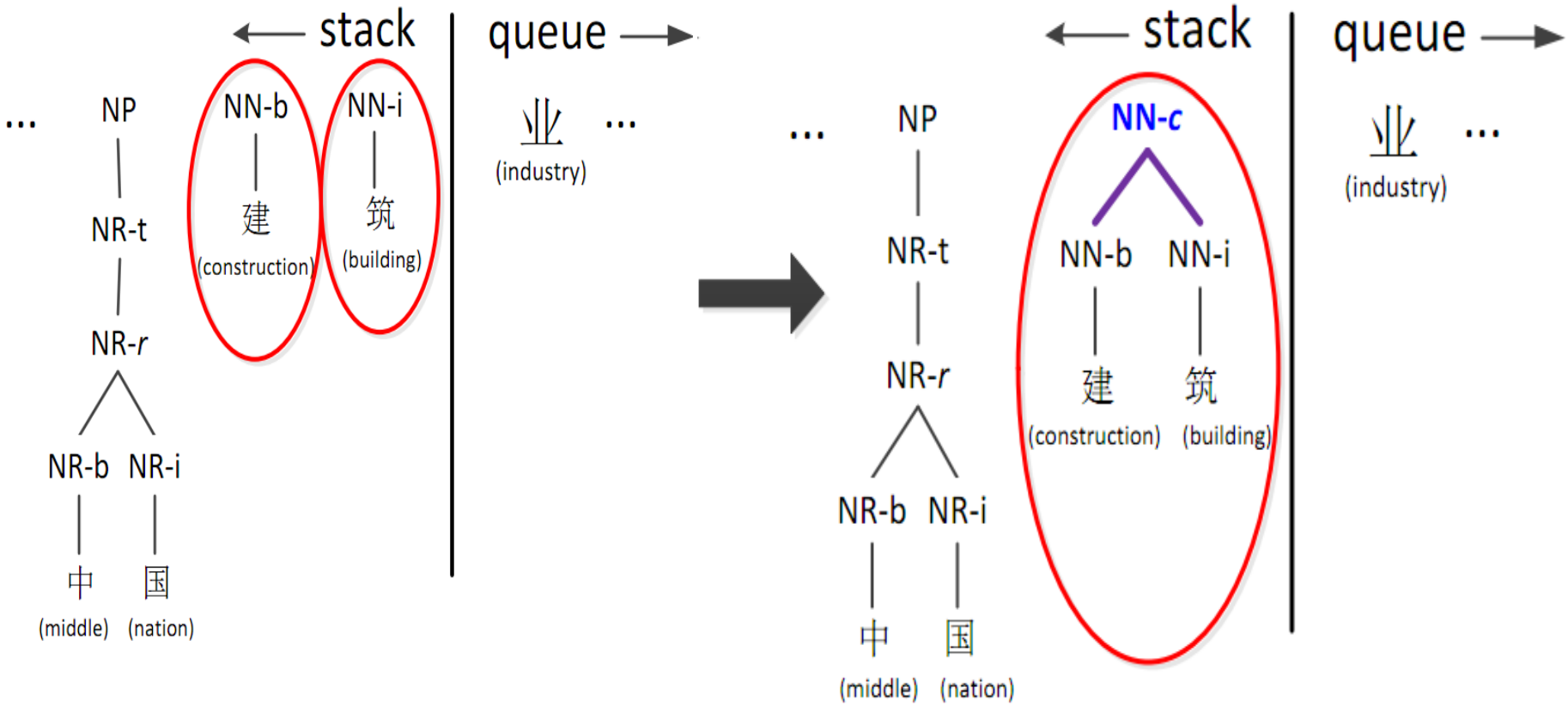

Transition Actions

- REDUCE-WORD

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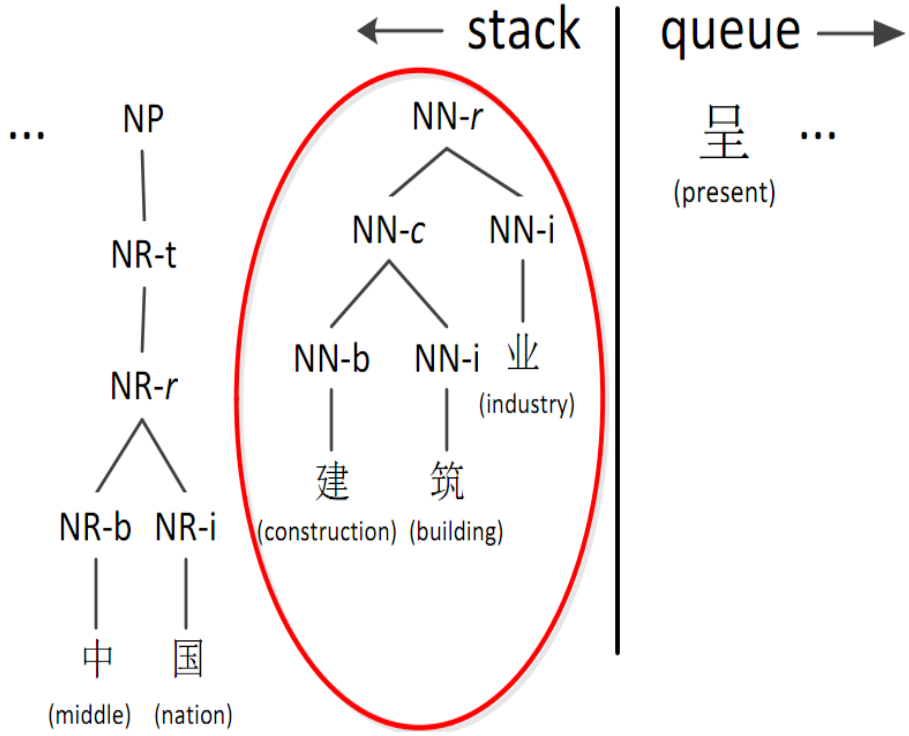

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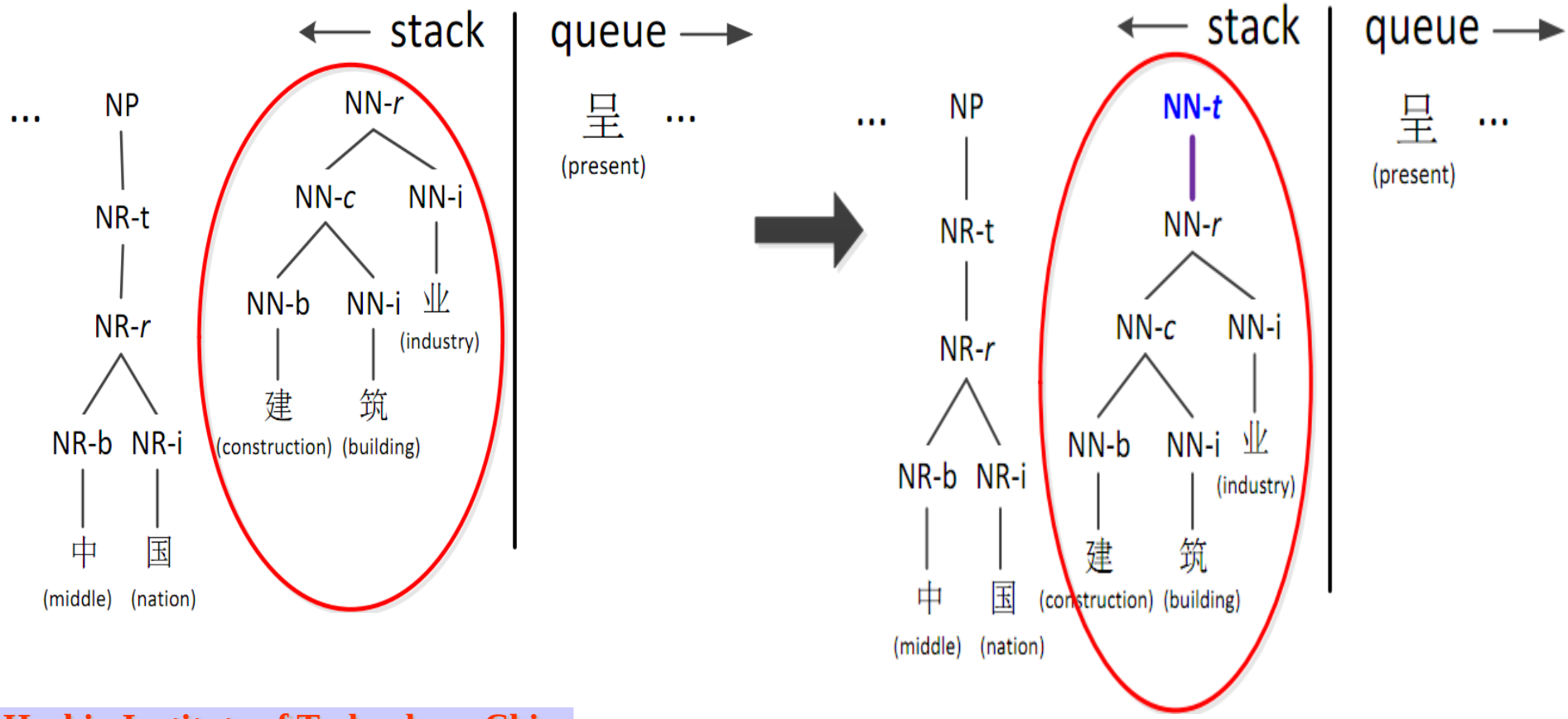

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- REDUCE-BINARY(*d; l*)

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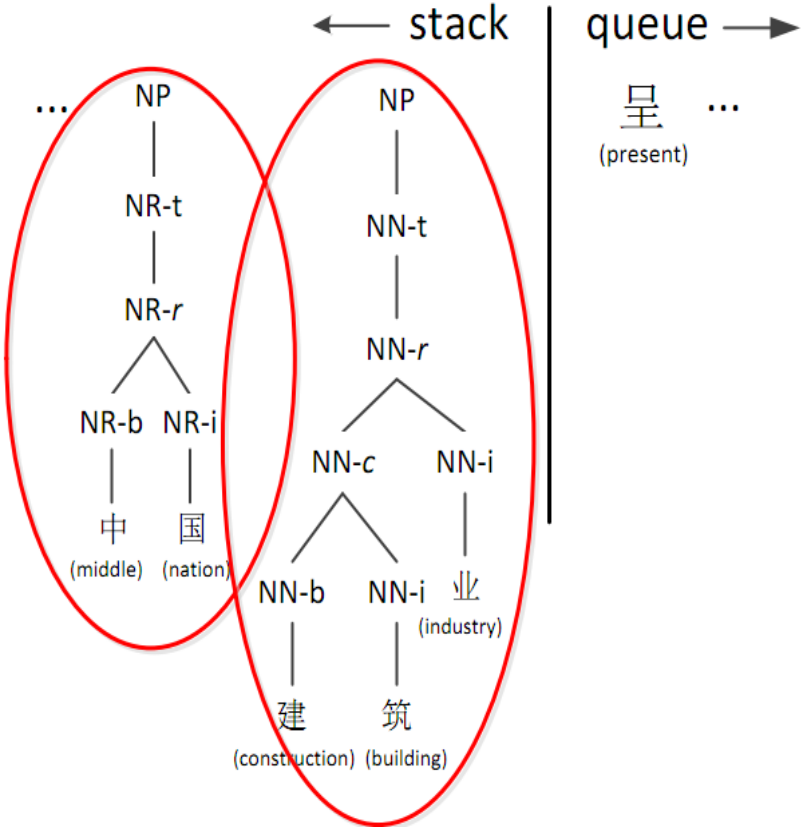

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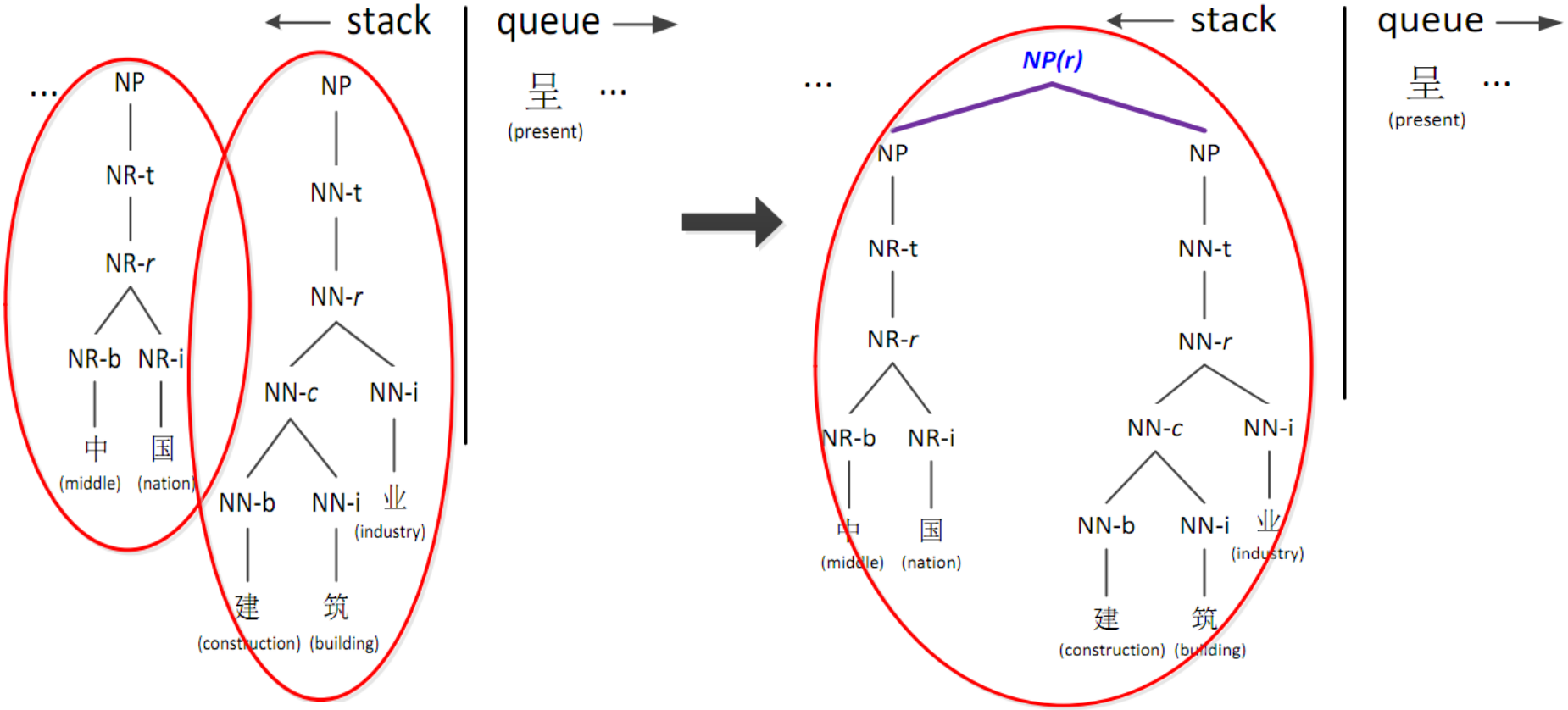

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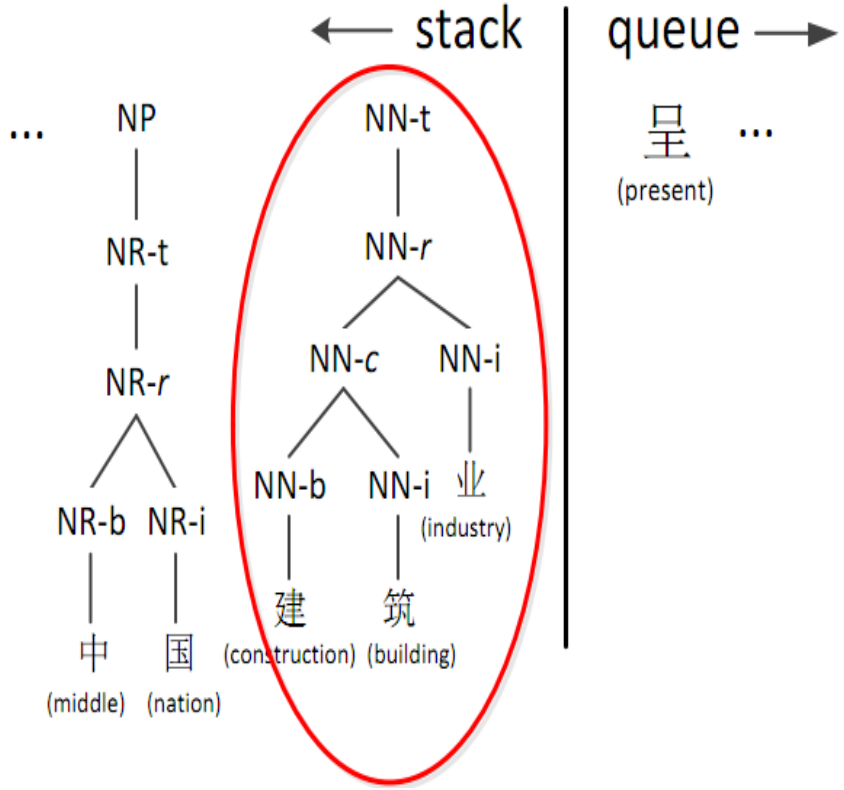

Transition Actions

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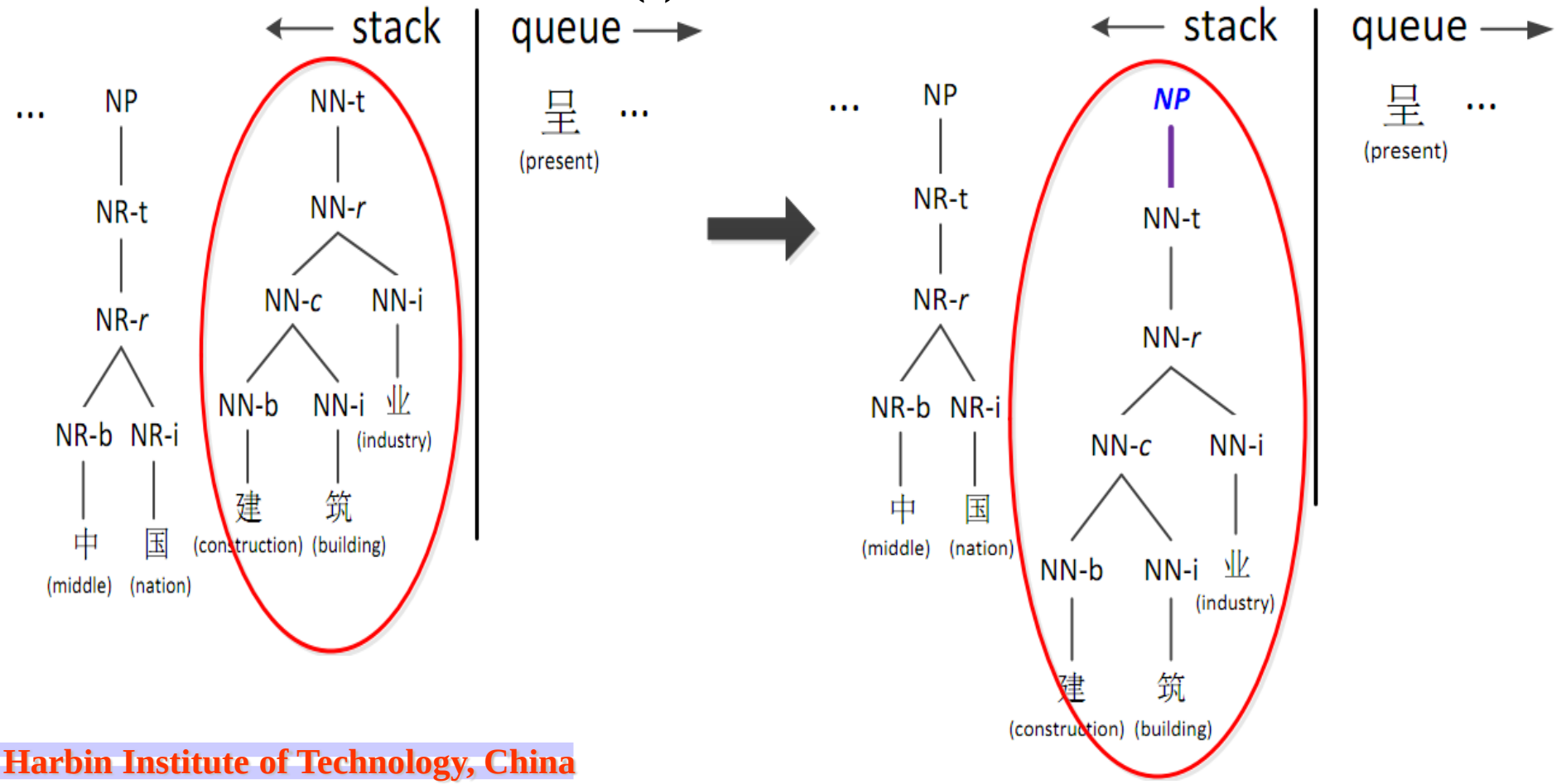

Transition Actions

- TERMINATE

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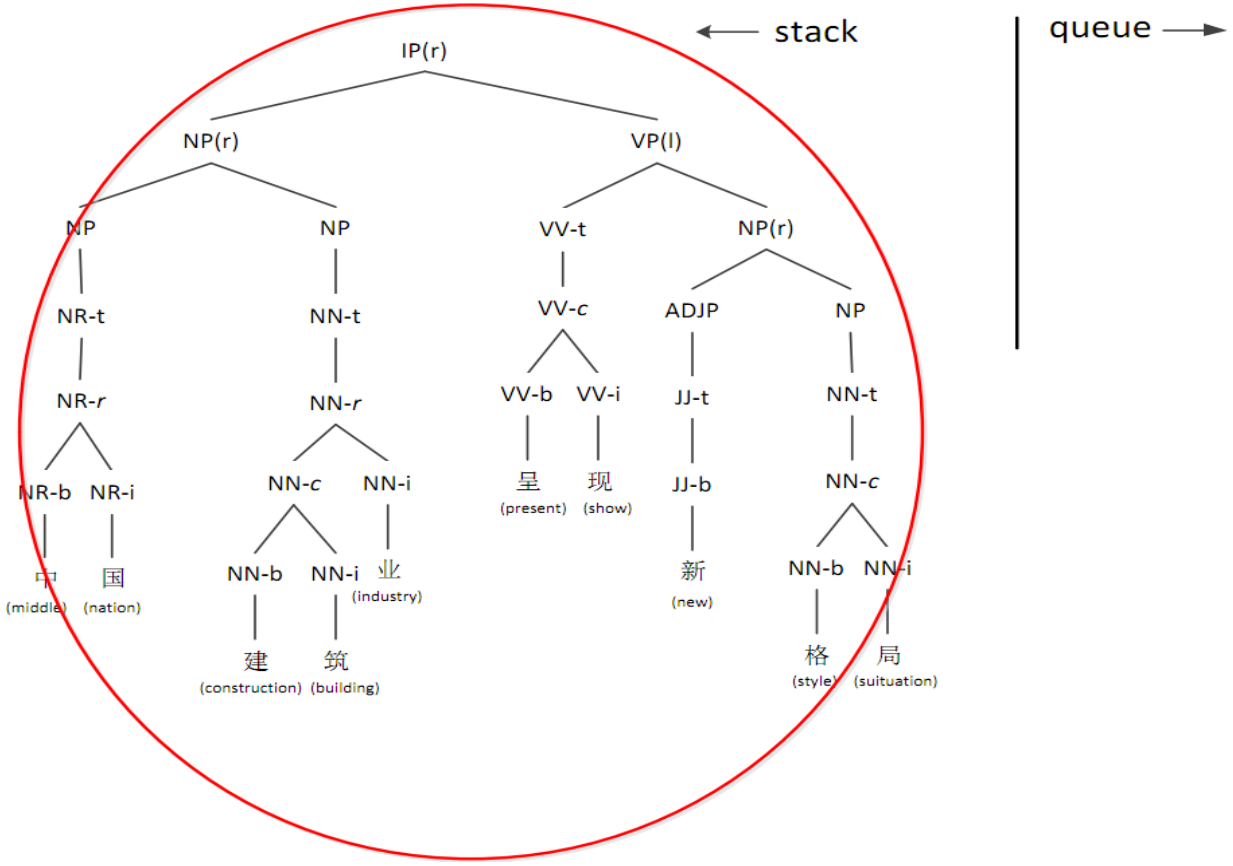

Features

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- From word-based parser (Zhang and Clark, 2009)

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Deep Character Features

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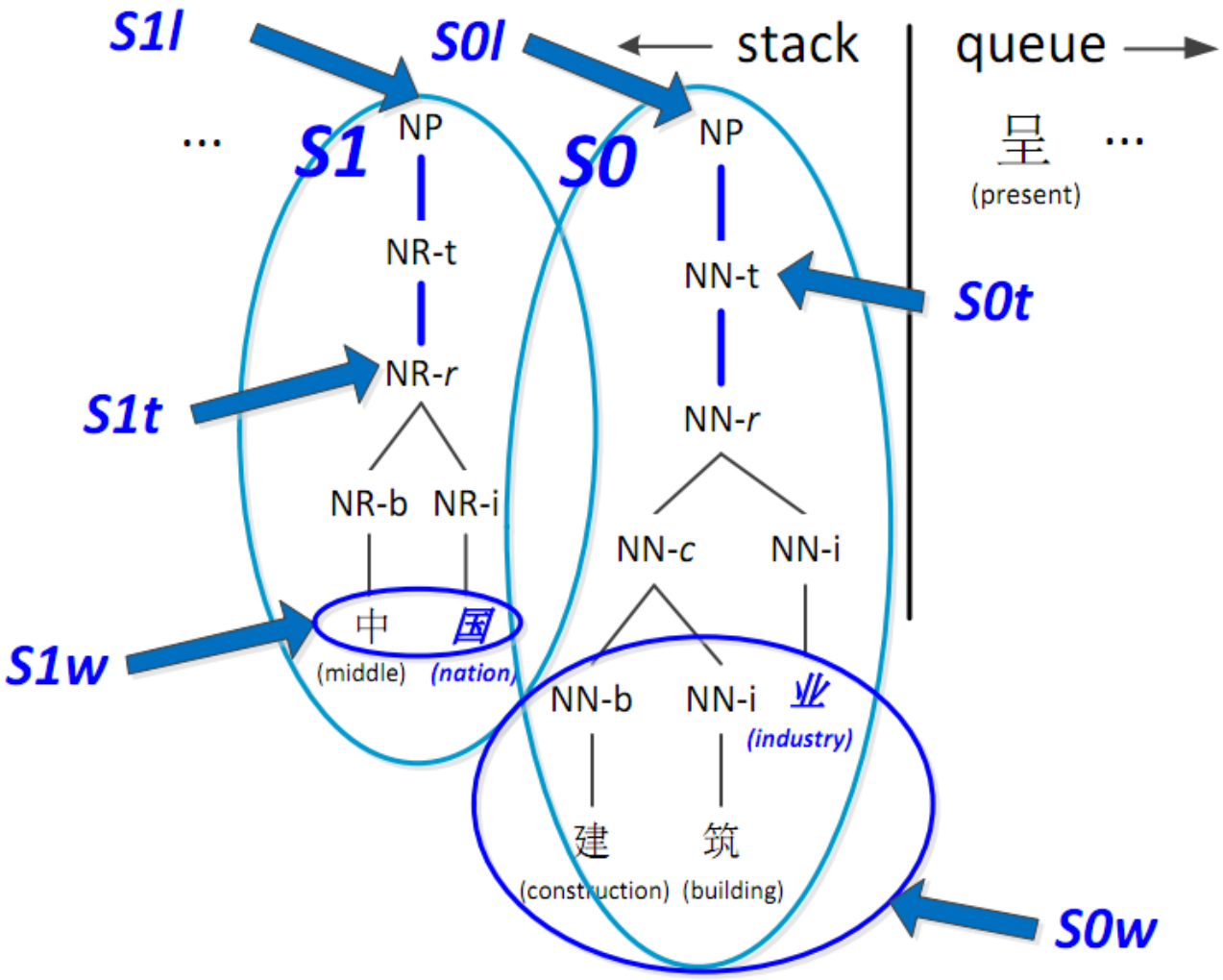
S1l
S0l
stack
queue
...
S1
S0
NP
NR-t
NR-r
NR-b
NR-i
中
(middle)
国
(nation)
NP
NN-t
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呈
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...
S0t
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S1w
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NN-i
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(industry)
建
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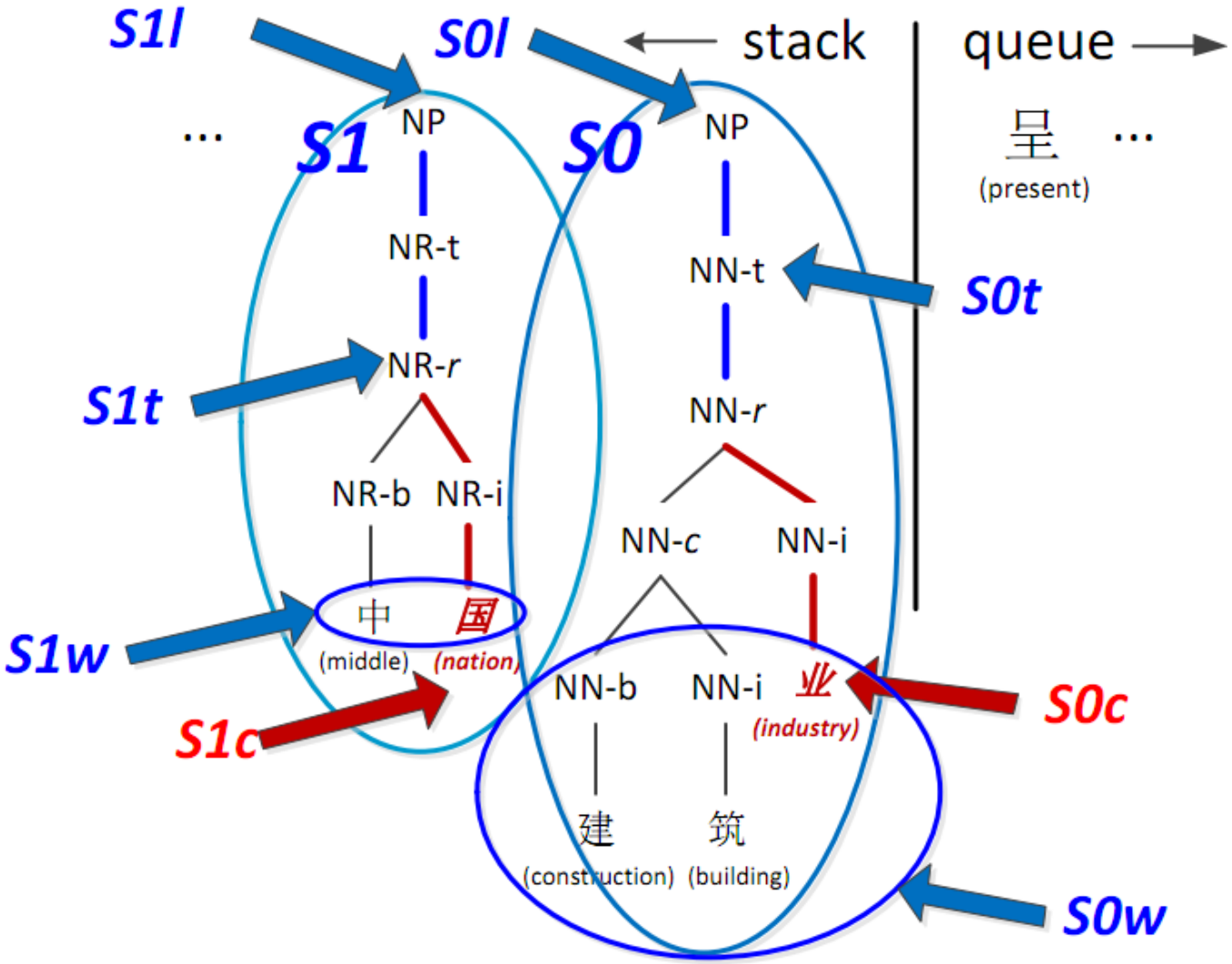
筑
(building)
S0w

Features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- Penn Chinese Treebank 5 (CTB-5)

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	CTB files	# sent.	# words
Training	1-270 400-1151	18089	493,939
Develop	301-325	350	6,821
Test	271-300	348	8,008

Experiments

- Baseline models
  - Pipeline model including:
    - Joint SEG&POS-Tagging model (Zhang and Clark, 2010).
    - Word-based constituent parser (Zhang and Clark, 2009).

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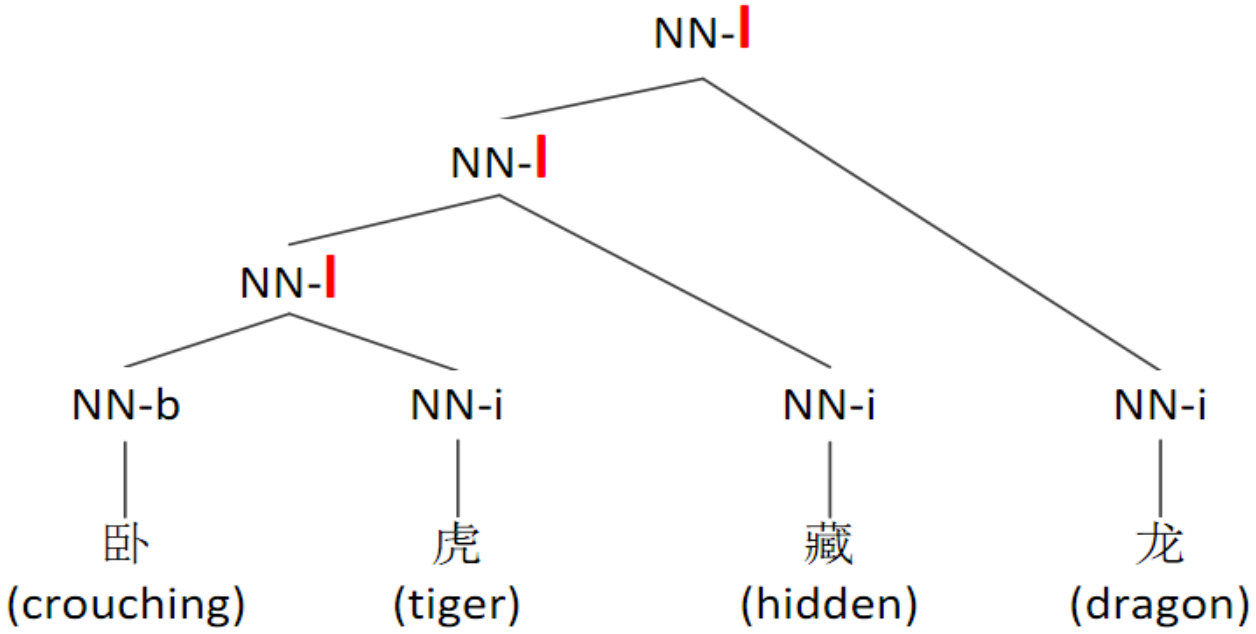

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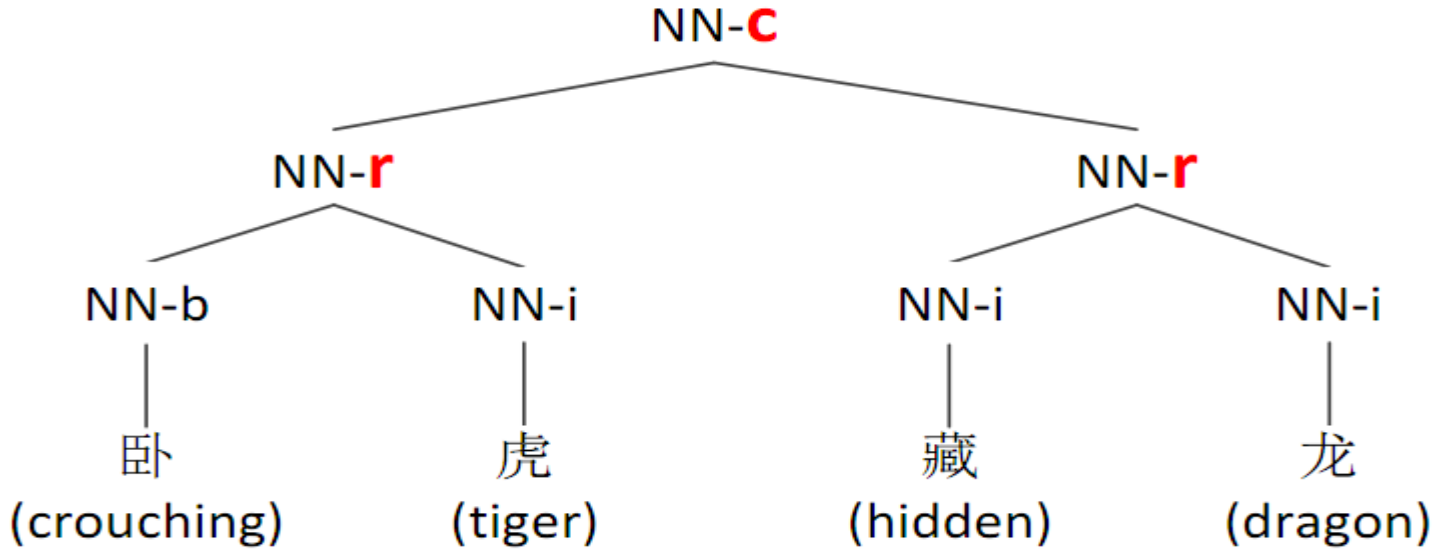

Results

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	Task	P	R	F
Pipeline	Seg	97.35	98.02	97.69
	Tag	93.51	94.15	93.83
	Parse	81.58	82.95	82.26

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	Tag	93.51	94.15	93.83
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Flat word structures	Seg	97.32	98.13	97.73
	Tag	94.09	94.88	94.48
	Parse	83.39	83.84	83.61

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Pipeline	Seg	97.35	98.02	97.69
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	Parse	81.58	82.95	82.26
Flat word structures	Seg	97.32	98.13	97.73
	Tag	94.09	94.88	94.48
	Parse	83.39	83.84	83.61
Annotated word structures	Seg	97.49	98.18	97.84
	Tag	94.46	95.14	94.80
	Parse	84.42	84.43	84.43
	WS	94.02	94.69	94.35

Influence of Deep Character Features

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	Task	P	R	F
With deep character features	Seg	96.71	96.81	96.76
	Tag	94.12	94.22	94.17
	Parse	85.08	85.60	85.34
	WS	93.13	93.22	93.17

Influence of Deep Character Features

	Task	P	R	F
With deep character features	Seg	96.71	96.81	96.76
	Tag	94.12	94.22	94.17
	Parse	85.08	85.60	85.34
	WS	93.13	93.22	93.17
Without deep character features	Seg	96.59	96.46	96.53
	Tag	93.80	93.68	93.74
	Parse	84.60	84.90	84.75
	WS	92.76	92.64	92.70

Compare with Other Systems

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Task	Seg	Tag	Parse
Kruengkrai+ ’09	97.87	93.67	–
Sun ’11	98.17	94.02	–
Wang+ ’11	98.11	94.18	–
Li ’11	97.3	93.5	79.7
Li+ ’12	97.50	93.31	–
Hatori+ ’12	98.26	94.64	–
Qian+ ’12	97.96	93.81	82.85

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Li+ ’12	97.50	93.31	–
Hatori+ ’12	98.26	94.64	–
Qian+ ’12	97.96	93.81	82.85
Ours pipeline	97.69	93.83	82.26
Ours joint flat	97.73	94.48	83.61
Ours joint annotated	97.84	94.80	84.43

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- We developed an high-performance character-level transition-based parser that cab jointly parse the word structures and the phrase structures.
- We proposed a set of deep character features for our parser that are effective for POS-tagging and syntax parsing.

Thank you

- Data
  - https://github.com/zhangmeishan/wordstructures .
- Code
  - http://sourceforge.net/projects/zpar/ , version 0.6.