HC-search for Incremental Parsing

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Standard Incremental Parsing

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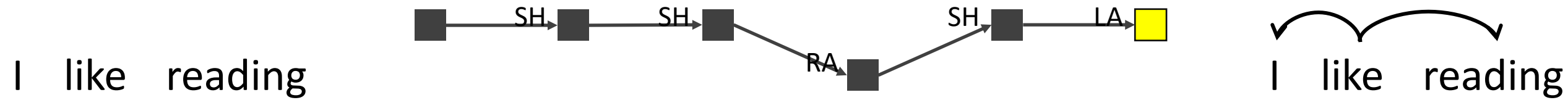

Standard Incremental Parsing

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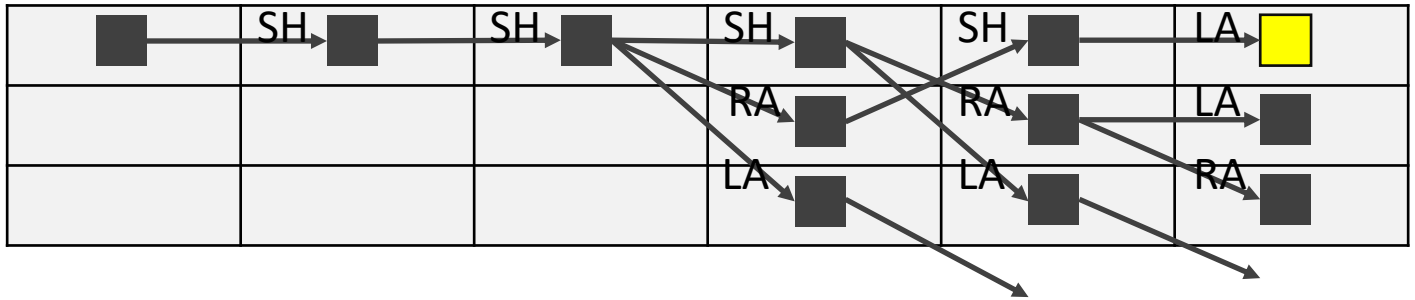

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Learning in Standard Incremental Parsing

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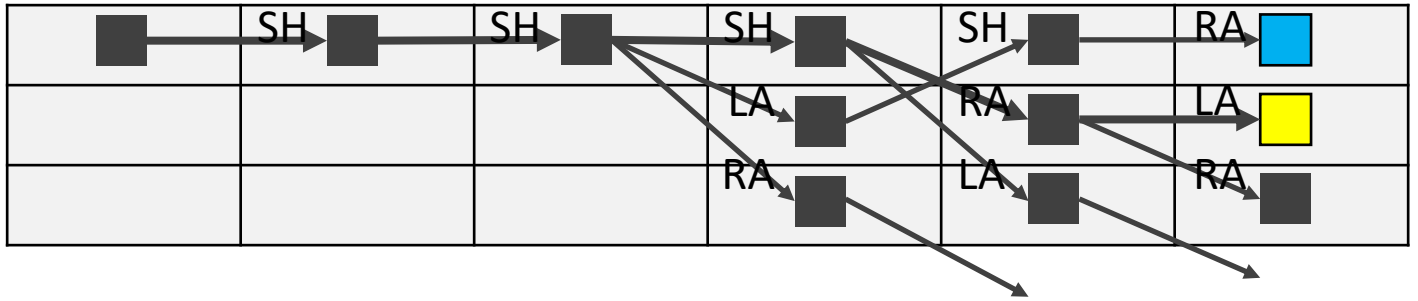

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- Goal: learning a function ***S*** to give ***oracle sequence*** highest score
- Typical learning scheme:
  - do beam search on input
  - if an error is made (***highest sequence*** != ***oracle sequence***):
    - increase weight for oracle sequence
    - decrease weight for highest sequence

Two types of Errors in Learning Standard Incremental Parsing

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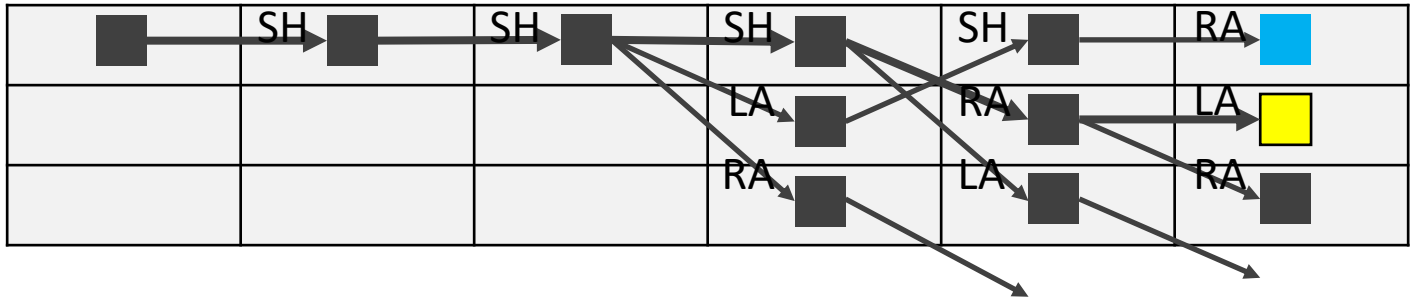

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oracle sequence/gold tree stays in beam at the final step but **not the highest** scoring one

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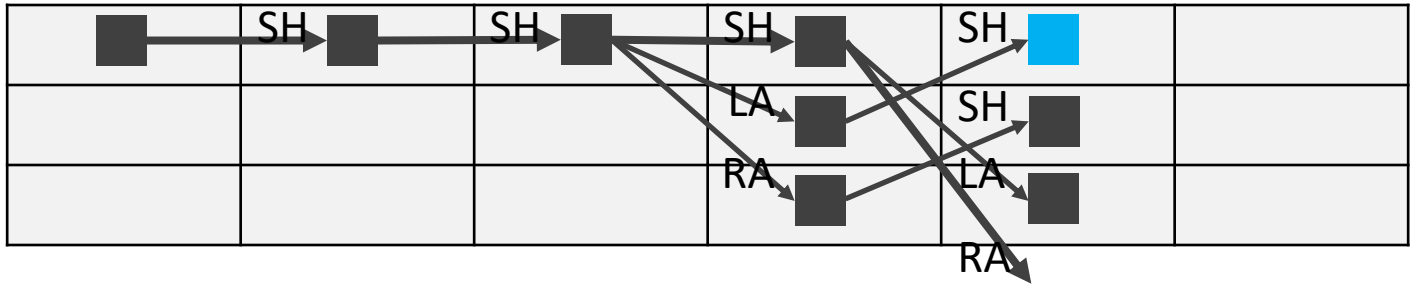

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oracle sequence falls out beam

Two types of Errors in Learning Standard Incremental Parsing

- a function ***S*** services a dual-role:
  - scoring *gold tree* highest (reduce first type errors)
  - keeping *gold tree* in beam (reduce second type errors)

Ambiguous in Transition System

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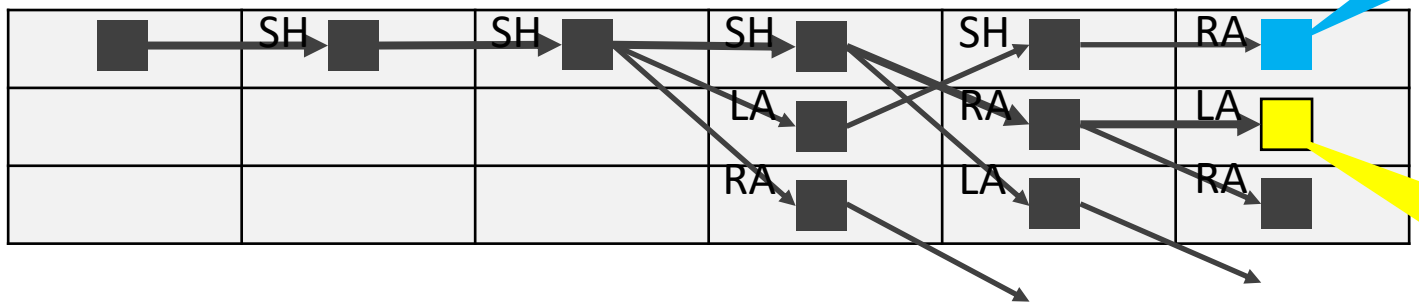

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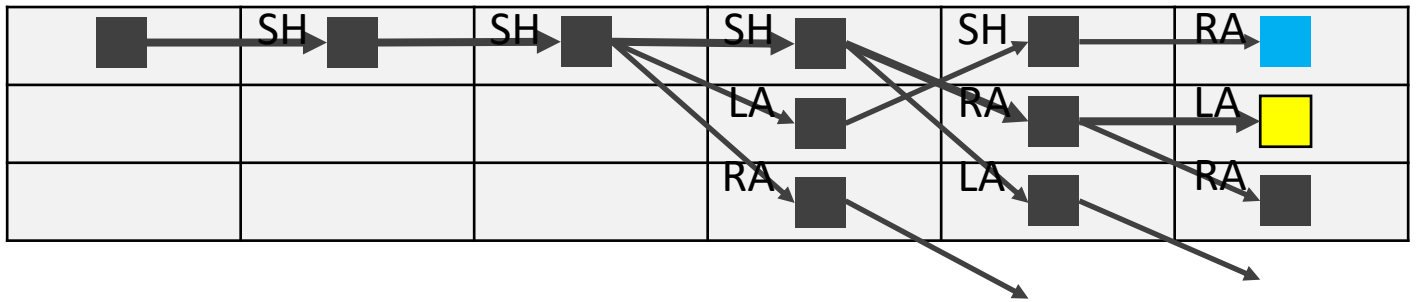
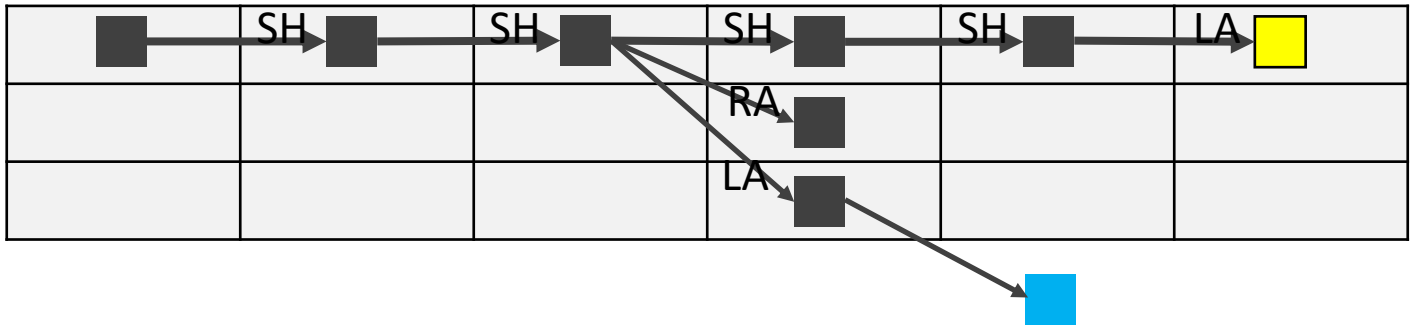
- decreasing weight for ***highest sequence*** results in wrong punishment
- single function ***S*** serves the dual-role can be problematic
  - due to two roles conflict sometimes

Ambiguous in Transition System



after updates



$\mathcal{HC}$-search Framework

- Doppa et al., 2014:
  - structure prediction error is decomposed into two parts
  - $\mathcal{H}$euristic part: the gold structure not included in the set of outputs
  - $\mathcal{C}$ost part: the gold structure not ranked as the highest output

$$\mathcal{E}_{\mathcal{HC}} = \underbrace{L(x, y^*_{\mathcal{H}}, y^*)}_{\epsilon_{\mathcal{H}}} + \underbrace{L(x, \hat{y}, y^*) - L(x, y^*_{\mathcal{H}}, y^*)}_{\epsilon_{\mathcal{C}|\mathcal{H}}},$$

Our method

- Decompose ***S*** into two functions $\mathcal{H}$ and $\mathcal{C}$
  - Goal of $\mathcal{H}$: include gold tree in the output
  - Goal of $\mathcal{C}$: rank the gold tree highest
- Mitigating the ambiguous problem
  - $\mathcal{H}$ not necessarily rank oracle sequence highest

Our method

- $\mathcal{H}$-step learning scheme
  - do beam search on input
  - if ***oracle sequence*** falls out beam:
    - increase weight for oracle sequence
    - pick a sequence from beam and decrease its weight
    - We tried pick the *BEST* scored and *WORST* scored

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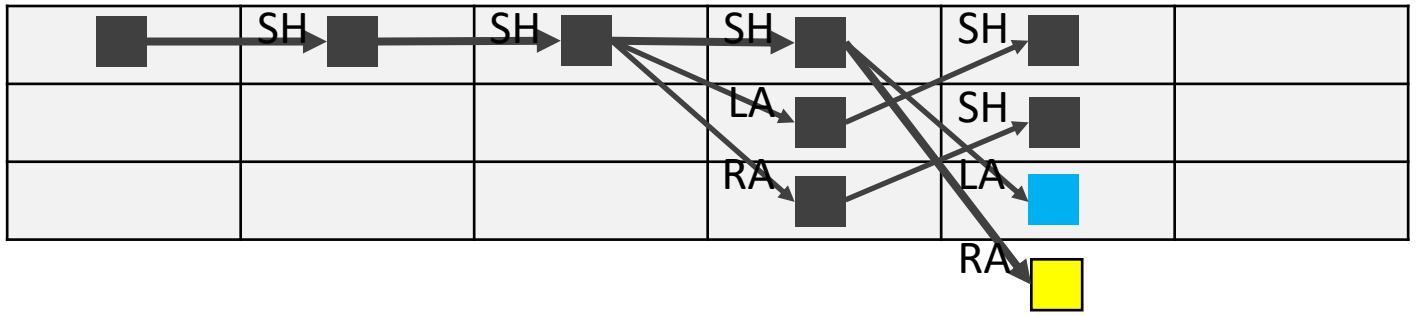

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Our method

- $\mathcal{C}$-step learning scheme
  - a typical ranking problem
    - employing a evaluation function on the set of outputs
  - *COARSE* grain ranking:
    - rank the best outputs higher than the rest
  - *FINE* grain ranking:
    - rank the better outputs higher

Experiment

- On PTB and CTB5, beam = 64

Parser	PTB			CTB5		
	Dev	Test	SPD	Dev	Test	SPD
BASELINE	92.95	92.48	1x	86.76	86.44	1x
BASELINE+FINE	93.06	92.53 (+0.05)		87.07	86.70 (+0.26)	

Experiment

- On PTB and CTB5, beam = 64

Parser	PTB			CTB5		
	Dev	Test	SPD	Dev	Test	SPD
BASELINE	92.95	92.48	1x	86.76	86.44	1x
BEST+FINE	**93.13**	**92.76** (+0.28)	1.25x	87.25	87.04 (+0.60)	1.08x
BEST+COARSE	92.94	92.44 (-0.04)	1.30x	86.61	86.51 (+0.07)	1.07x
WORST+FINE	93.12	92.73 (+0.25)	1.33x	**87.27**	**87.15** (+0.71)	1.22x
WORST+COARSE	92.89	92.47 (-0.01)	1.30x	86.95	86.82 (+0.38)	1.20x
BASELINE+FINE	93.06	92.53 (+0.05)		87.07	86.70 (+0.26)	

Error Decomposition Analysis

Parser	PTB			CTB5		
	$\epsilon_{\mathcal{H}}$	$\epsilon_{\mathcal{C}\|\mathcal{H}}$	$\mathcal{E}_{\mathcal{HC}}$	$\epsilon_{\mathcal{H}}$	$\epsilon_{\mathcal{C}\|\mathcal{H}}$	$\mathcal{E}_{\mathcal{HC}}$
BEST+FINE	3.69	**3.90**	**6.87**	8.77	**5.72**	12.75
BEST+COARSE		4.14	7.06		6.93	13.39
WORST+FINE	**3.05**	4.62	6.88	**7.75**	7.33	**12.73**
WORST+COARSE		5.09	7.11		7.58	13.05
BASELINE+FINE	3.70	4.10	6.94	8.81	6.27	12.93

- Relaxed $\mathcal{H}$-step learning objective
  - recall more high-quality output
  - increase difficulty of ranking

Conclusion

- We decompose incremental parsing loss based on the HC-search.
- We propose the relaxed H-step learning objective that recalls more high-quality outputs
- We found fine-grained ranking is more suitable for ranking in parsing
- Code can be found at: https://github.com/ExpResults/hc-incremental-parsing

Thanks and Questions!