A Two-Stage Parsing Method for Text-Level Discourse Analysis

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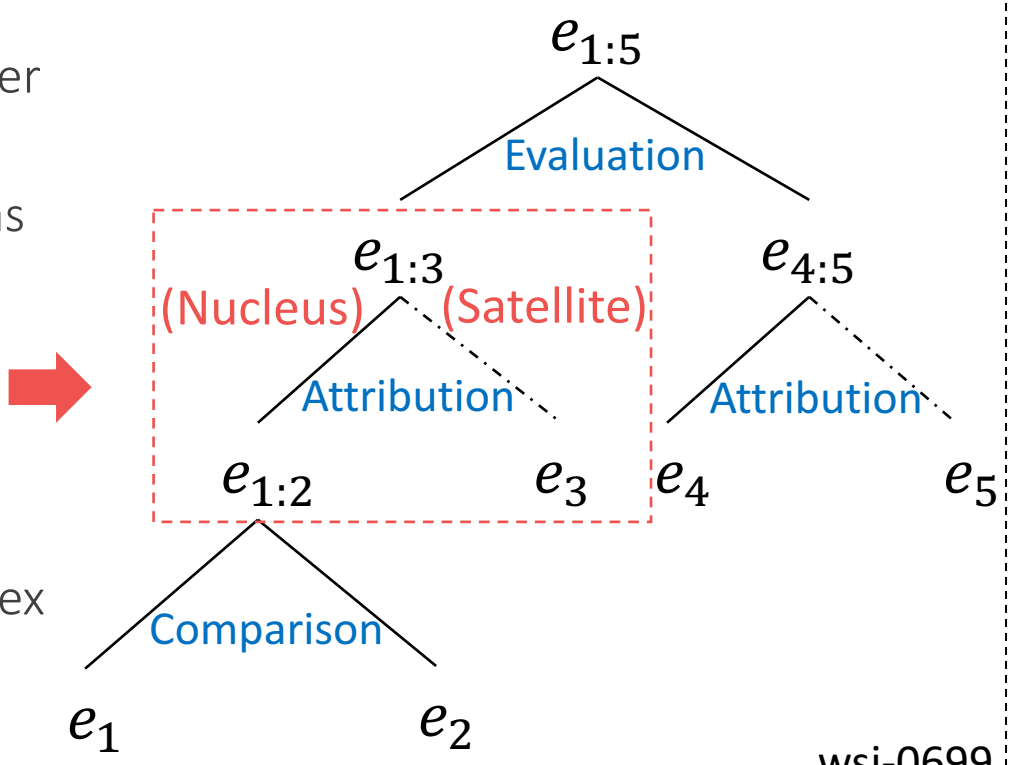
Background: Text-Level Discourse Analysis

- Task: Identifying the discourse structure of text.
- Rhetorical Structure Theory [Mann and Thompson, 1988]

[The European Community's consumer price index rose a provisional 0.6% in September from August]^{e_1} [and was up 5.3% from September 1988,]^{e_2}
[according to Eurostat, the EC's statistical agency.]^{e_3}

[The month-to-month rise in the index was the largest since April,]^{e_4}
[Eurostat said.]^{e_5}



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Background: Text-Level Discourse Analysis

Goal: parse a text into a tree with nuclearity and relation labels

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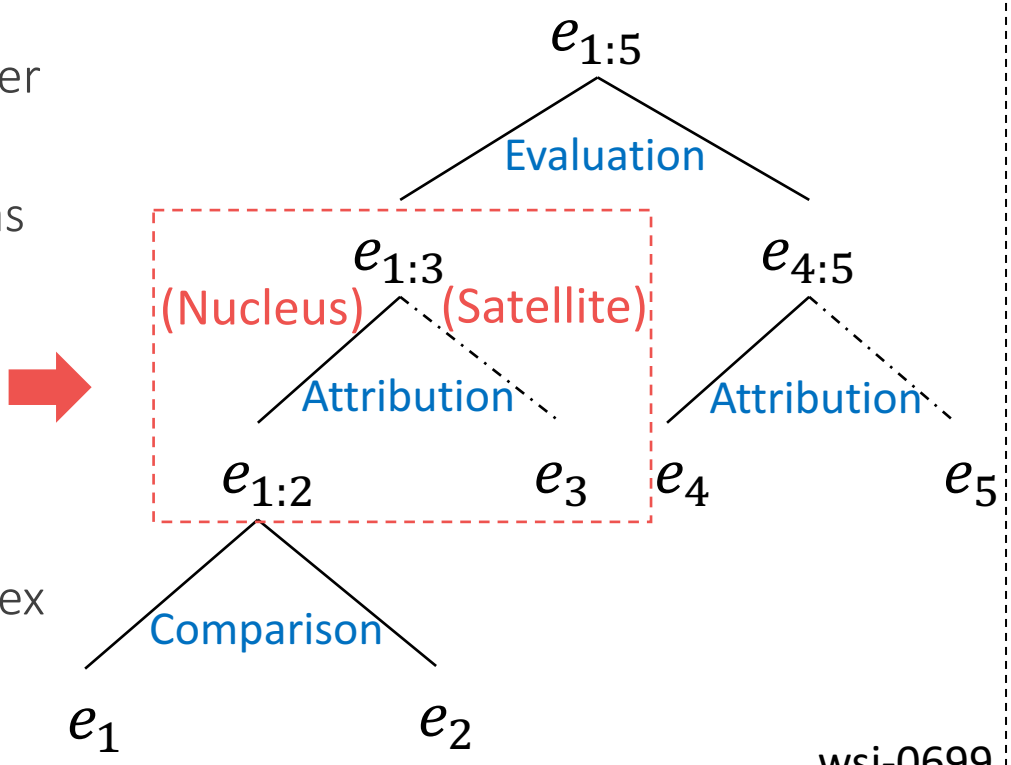

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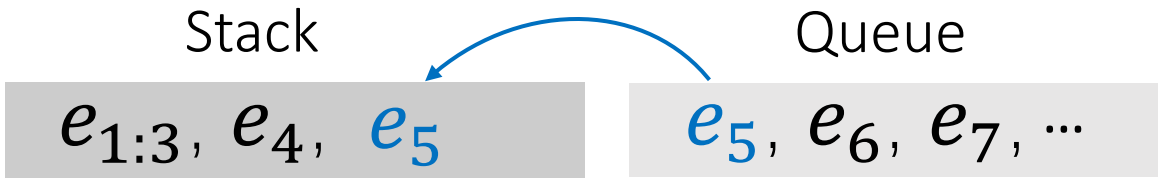
Background: Transition-Based Method

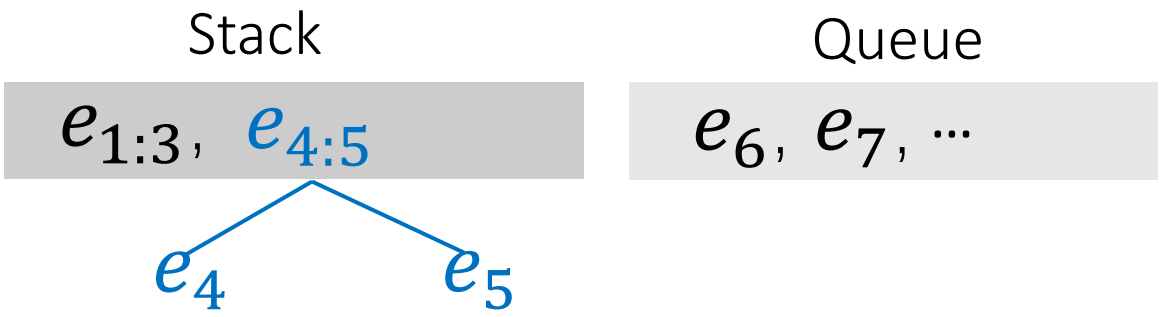
[Daniel Marcu. 1999; Kenji Sagae. 2009]

- Initial state:

- Shift action:



- Reduce action:



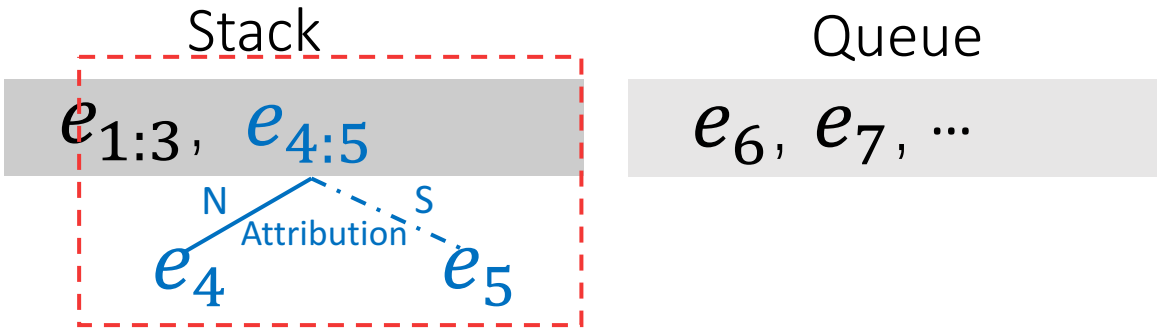
Background: Transition-Based Method

[Daniel Marcu. 1999; Kenji Sagae. 2009]

- The unified framework:

42 reduce actions are designed with 3 different nuclearity types (e.g. NS) and 18 relation labels (e.g. cause) .

- Reduce action combined with nuclearity and relation:



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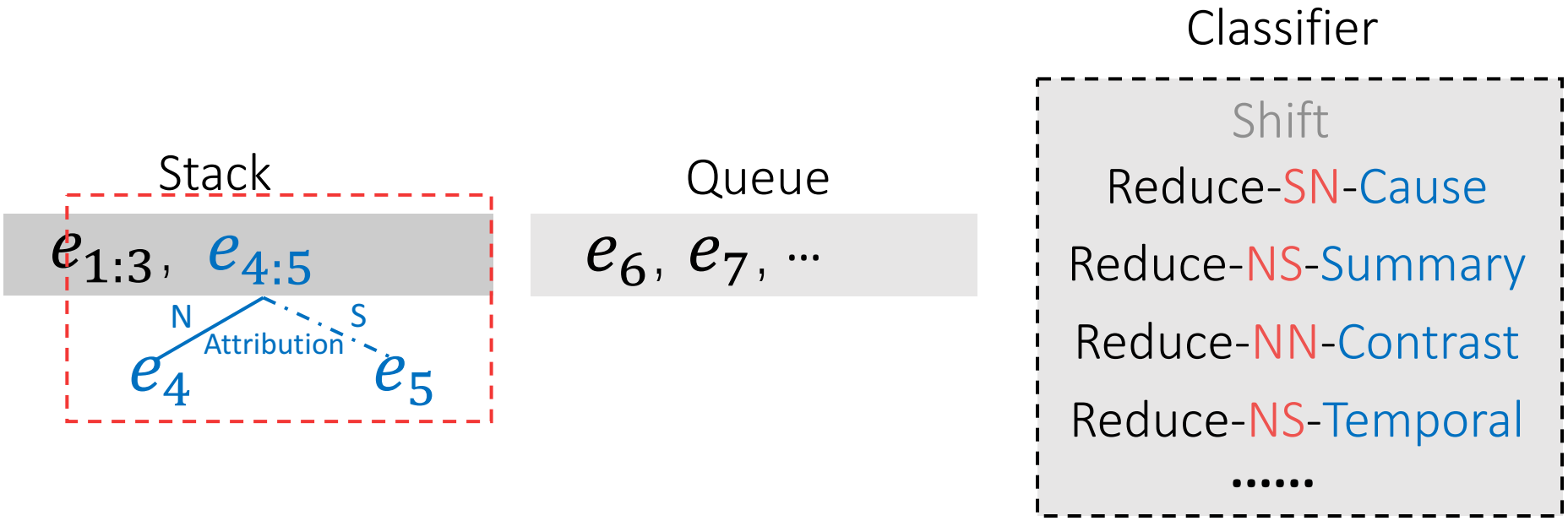
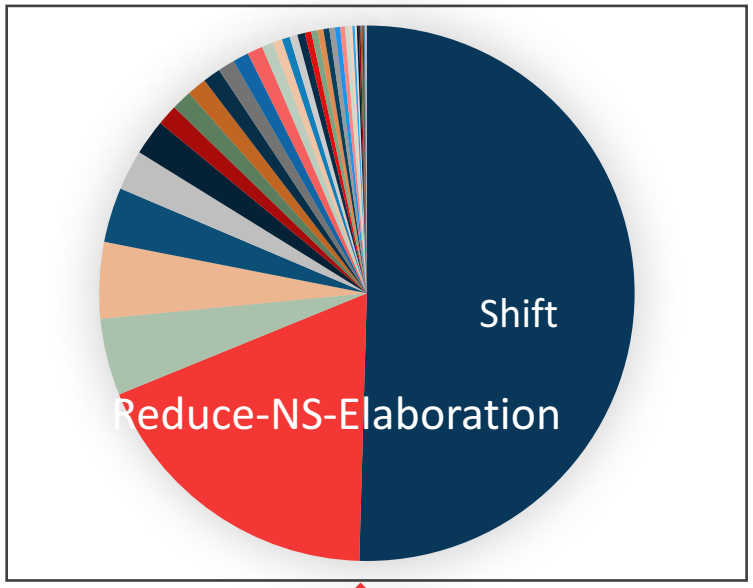


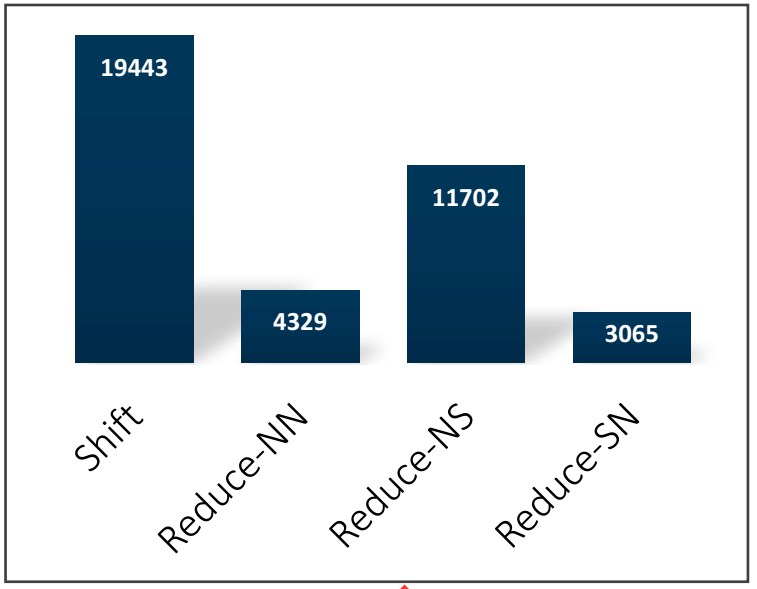
Motivation: Naked Tree for Reducing Sparsity

Distribution of the 42 actions in Previous Transition-based Parsing Systems

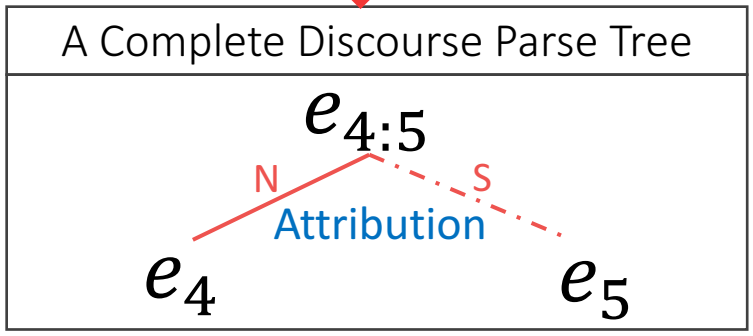


remove relation

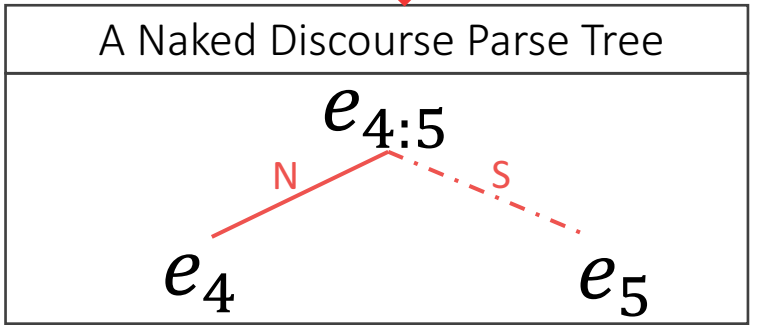
Number of the 4 actions that we need to build a **naked tree** (without relation)



A Complete Discourse Parse Tree



A Naked Discourse Parse Tree



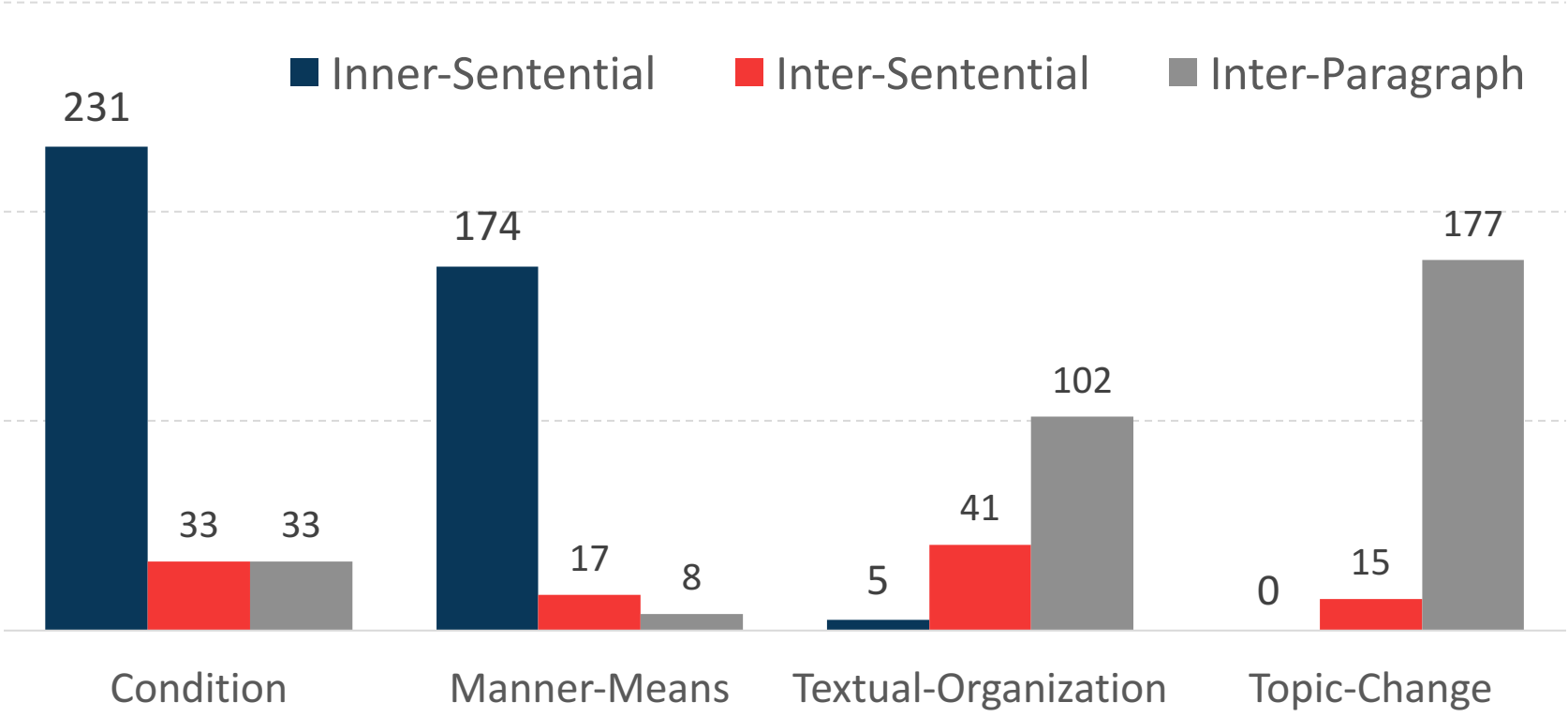
Motivation: Level-Specific Relation Labelling

- Discourse relations distribute differently at different linguistic levels:

Top-5 Frequent Inner-Sentential Relations		**Top-5 Frequent Inter-Sentential Relations**		**Top-5 Frequent Inter-Paragraph Relations**	
Elaboration	32.70 %	Elaboration	44.4 %	Elaboration	43.10%
Attribution	23.00 %	Joint	12.7 %	Joint	13.80%
Same-Unit	10.90 %	Explanation	9.2 %	Explanation	7.60%
Joint	6.60 %	Contrast	7.6 %	Contrast	6.40%
Enablement	4.30 %	Evaluation	5.3 %	Evaluation	5.90%

Motivation: Level-Specific Relation Labelling

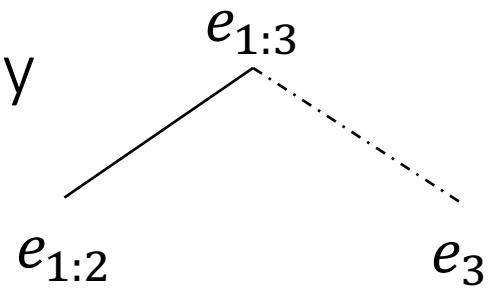
- Some discourse relations tend to occur at specific linguistic levels:



Method: Two-Stage Parsing Algorithm

- **Stage 1:**

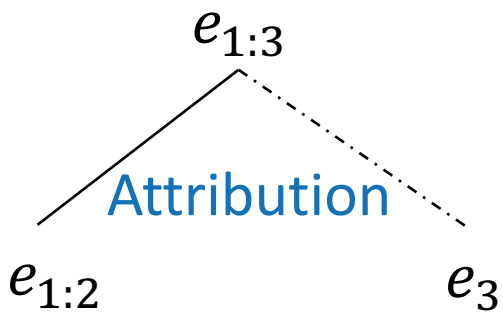
  Transition-based parsing system with only 4 actions is adopted to construct the naked tree (without labels).



- **Stage 2:**

  Three dedicated classifiers are trained for labelling relations at three linguistic levels:

  a) intra-sentential
  b) inter-sentential
  c) inter-paragraph



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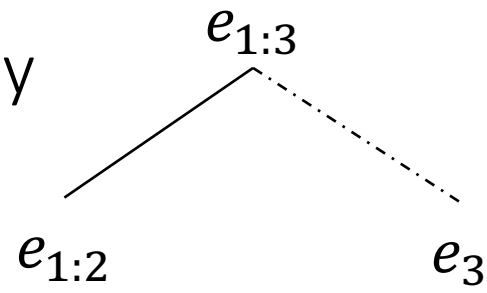

Naked tree structure could help with relation classification.

- **Stage 2:**

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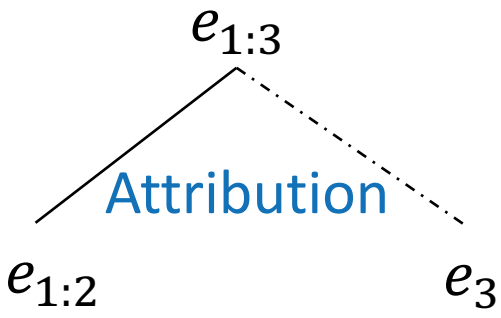


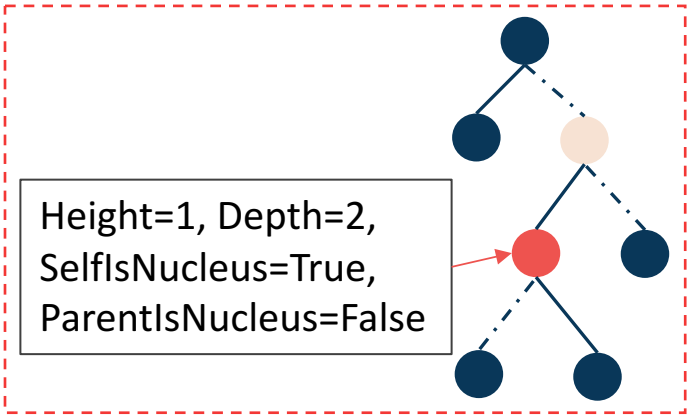
Method: Features and Classifiers

- We use manually-extracted features, including:

  a) Parsing status, position features (only for stage 1)

  b) N-gram features, dependency features, structural features, nucleus features

  c) Tree features (only for stage 2) :



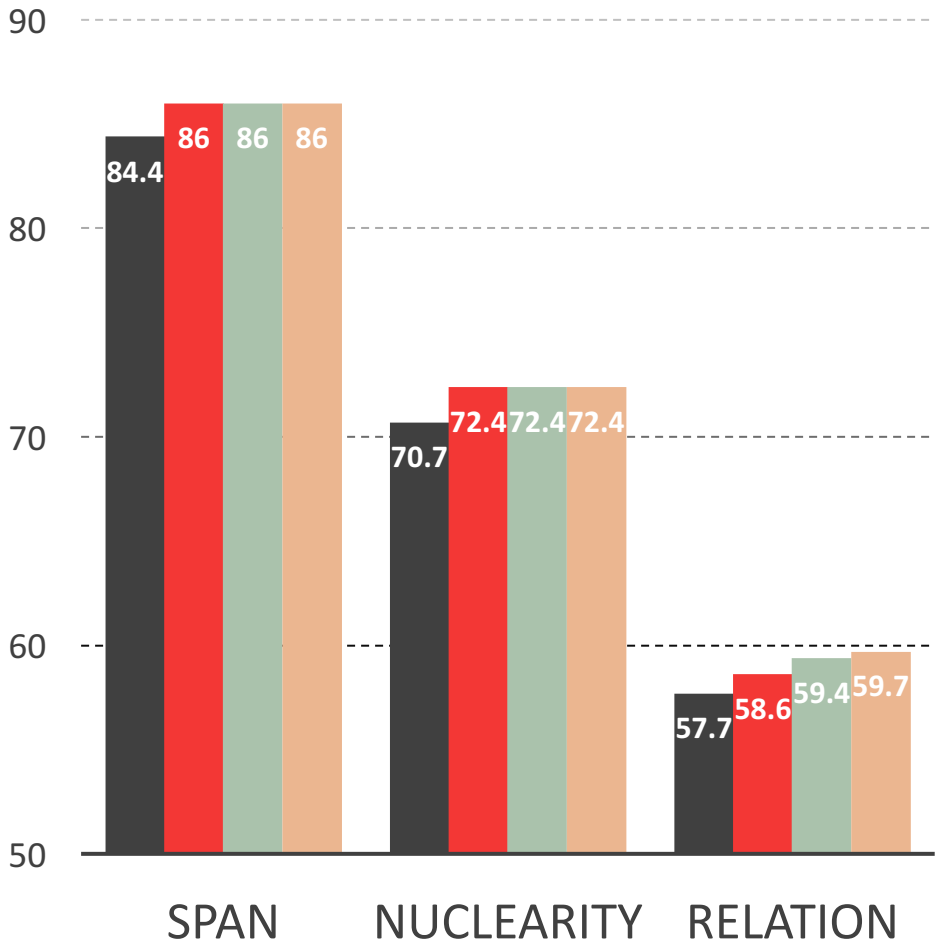
- Four SVM classifiers are trained for the four classification tasks (one action classifier and three relation classifier).

Experiments: Performance Comparison

- We evaluate our method on RST Discourse Treebank, and report the (micro-averaged) F-score:

	Model	Span	Nuclearity	Relation
	Joty et al. (2013)	82.7	68.4	55.7
	Feng and Hirst (2014)	85.7	71.0	58.2
	Li et al. (2014)	84.0	70.8	58.6
	Li et al. (2016)	85.8	71.1	58.9
Transition-Based Systems	Ji and Eisenstein (2014)	82.1	71.1	**61.6**
	Heilman and Sagae (2015)	83.5	69.3	57.4
	Ours	**86.0**	**72.4**	59.7
	Human	88.7	77.7	65.8

Experiments: Incremental Analysis of Our Method



- Simple Unified Framework
- Two-Stage Parsing (Basic)
  - Span: ⇈ 1.6 %
  - Nuclearity: ⇈ 1.7 %
  - Relation: ⇈ 0.9 %
- + Three-Level Relation
  - Relation: ⇈ 0.8 %
- + Tree Features
  - Relation: ⇈ 0.3 %

Conclusions

- Summary:
  - A pipelined two-stage discourse parsing method;
  - Three-level relation classification with tree features;
  - State-of-the-art performance.
- Future work:
  - Update the features and classifiers with latest models;
  - Incorporate data from other sources.

Thank you!

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Code is available:
https://github.com/EastonWang/StageDP