Leveraging discourse information effectively for authorship attribution

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Task

- **Authorship Attribution:** identify the author of a text, given a set of author-labeled training texts.

Authorship Attribution

- **Neural networks** (e.g., character-level CNNs) have proven very powerful…
  - capture stylometric cues at the surface level

> “My very photogenic mother died in a freak accident **(**picnic, lightning**)** when I was three…”

Lolita, Nabokov

> “But what principally attracted attention of Nicholas**,** was the old gentleman’s eye… Grafted upon the quaintness and oddity of his appearance**,** was something…”

Nichola Nickleby, Dickens

Authorship Attribution

- Authors also have particular **rhetorical** styles…
- But how do you incorporate discourse into a neural net?

Our Contributions

1) How can you *featurize* discourse information?

2) How can you *integrate* discourse information into the network?

3) Can discourse help in SOTA model (bigram character CNN)?

Q1: How can you *featurize* discourse information?

- Use an entity grid model (Barzilay & Lapata, 2008) with either:
    - grammatical relations, or
    - RST discourse relations

Q1: How can you *featurize* discourse information?

(1) My father was a clergyman of the north of England, who was deservedly respected by all who knew him; and, in his younger days, lived pretty comfortably on the joint income of a small incumbency and a snug little property of his own.

(2) My mother, who married him against the wishes of her friends, was a squire's daughter, and a woman of spirit.

(3) In vain it was represented to her, that if she became the poor parson's wife, she must relinquish her carriage and her lady's-maid, and all the luxuries and elegancies of affluence; which to her were little less than the necessaries of life.

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Q1: How can you *featurize* discourse information?

	father	mother
(1)		
(2)		
(3)		

row: sentence
column: salient entity

Barzilay and Lapata (2008)

Q1: How can you *featurize* discourse information?

(1) **[My father]SUBJECT** was a clergyman of the north of England, who was deservedly respected by all who knew him; and, in his younger days, lived pretty comfortably on the joint income of a small incumbency and a snug little property of his own.

(2) [My mother]SUBJECT, who married **[him]OBJECT** against the wishes of her friends, was a squire's daughter, and a woman of spirit.

(3) In vain it was represented to her, that if [she]SUBJECT became the **[poor parson]OTHER**'s wife, she must relinquish her carriage and her lady's-maid, and all the luxuries and elegancies of affluence; which to her were little less than the necessaries of life.

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Q1: How can you *featurize* discourse information?

	father	mother
(1)	S	-
(2)	O	S
(3)	X	S

Grammatical relations

Barzilay and Lapata (2008)

Q1: How can you *featurize* discourse information?

- Discourse relations:
  - Rhetorical Structure Theory (RST)
    - Divide a document into elementary discourse units (EDUs), usually clauses
    - Organize EDUs into a **tree** structure:
      - edges are discourse relation types
      - node in a relation can be either the nucleus (more “important”) or satellite

Q1: How can you *featurize* discourse information?

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Q1: How can you *featurize* discourse information?

condition-s

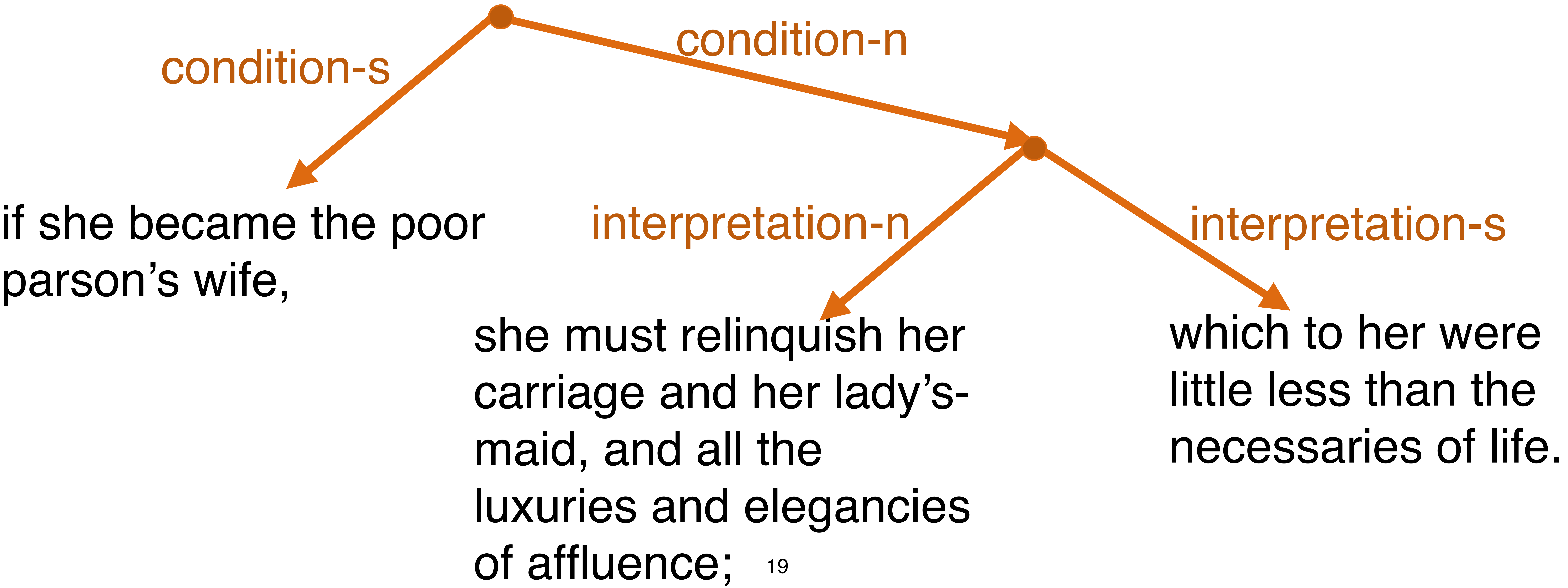
condition-n

if she became the poor parson’s wife,

she must relinquish her carriage and her lady’s-maid, and all the luxuries and elegancies of affluence;

which to her were little less than the necessaries of life.

Q1: How can you *featurize* discourse information?



condition-s

condition-n

if she became the poor parson’s wife,

interpretation-n

interpretation-s

she must relinquish her carriage and her lady’s-maid, and all the luxuries and elegancies of affluence;

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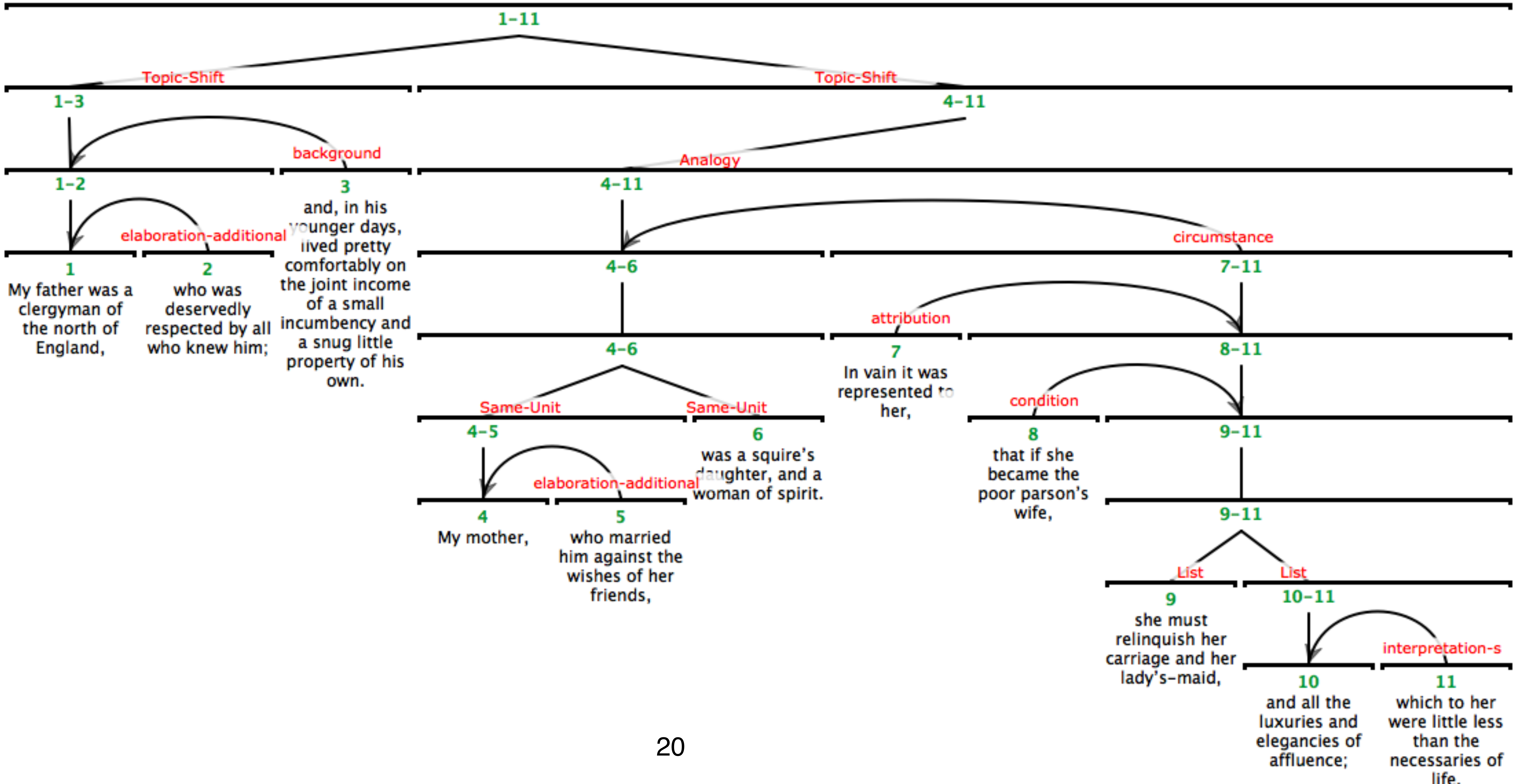
1-11
Topic-Shift
Topic-Shift
1-3
4-11
background
Analogy
1-2
3
4-11
and, in his younger days, lived pretty comfortably on the joint income of a small incumbency and a snug little property of his own.
elaboration-additional
circumstance
1
My father was a clergyman of the north of England,
2
who was deservedly respected by all who knew him;
4-6
7-11
attribution
4-6
7
In vain it was represented to her,
8-11
Same-Unit
Same-Unit
condition
4-5
6
was a squire's daughter, and a woman of spirit.
8
that if she became the poor parson's wife,
9-11
elaboration-additional
4
My mother,
5
who married him against the wishes of her friends,
9-11
List
List
9
she must relinquish her carriage and her lady's-maid,
10-11
interpretation-s
10
and all the luxuries and elegancies of affluence;
11
which to her were little less than the necessaries of life.

Q1: How can you *featurize* discourse information?

	father	mother
(1)	background.N, TopicShift, elaboration.S, background.S	-
(2)	elaboration.S	elaboration.N, circumstance.N, TopicShift
(3)	condition.N	attribution.S, condition.N, interpretation.S

RST discourse relations

Feng and Hirst (2014)

Q2: How can you *integrate* discourse information into the network?

- Use probability vector
- Use embeddings!

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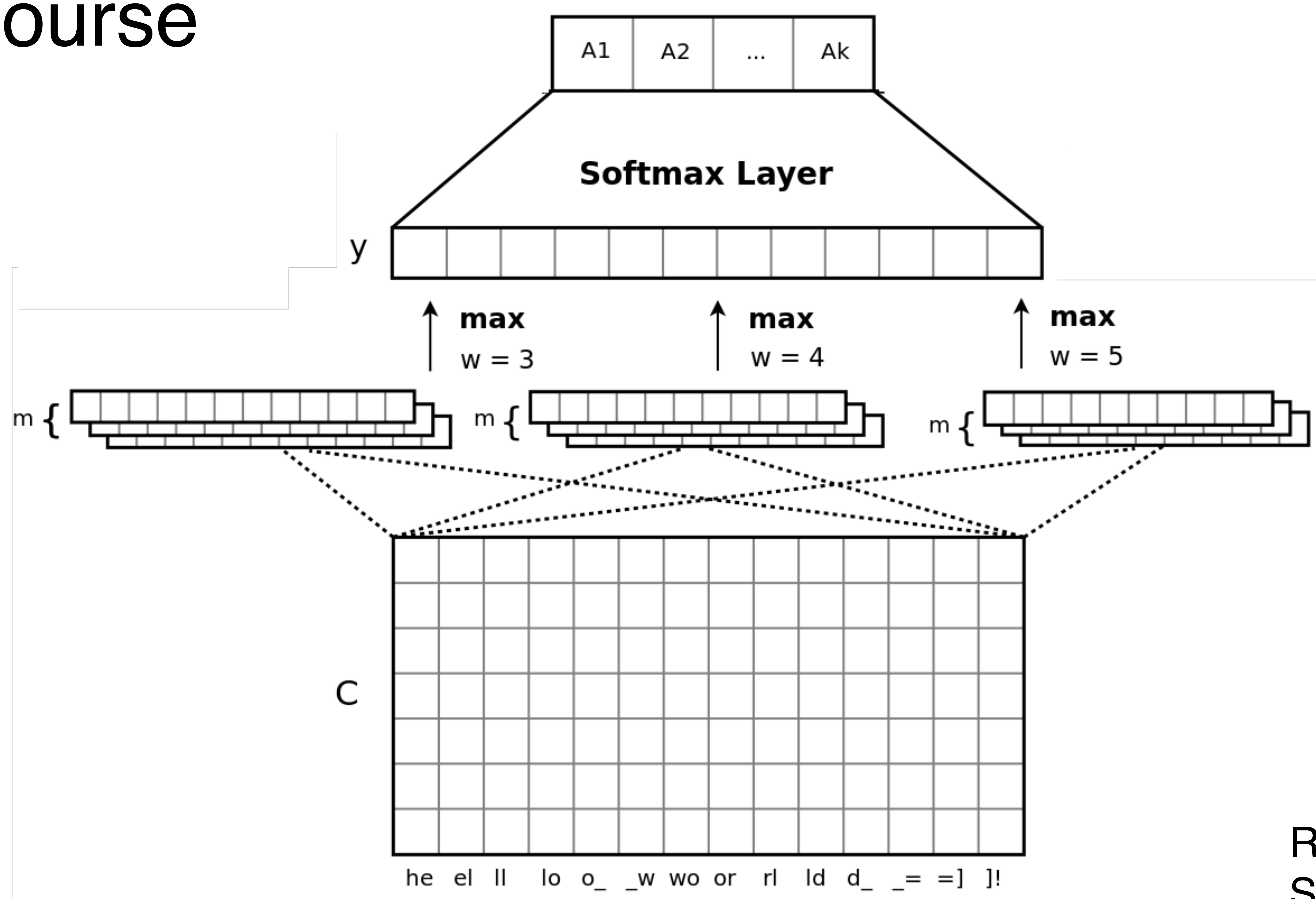
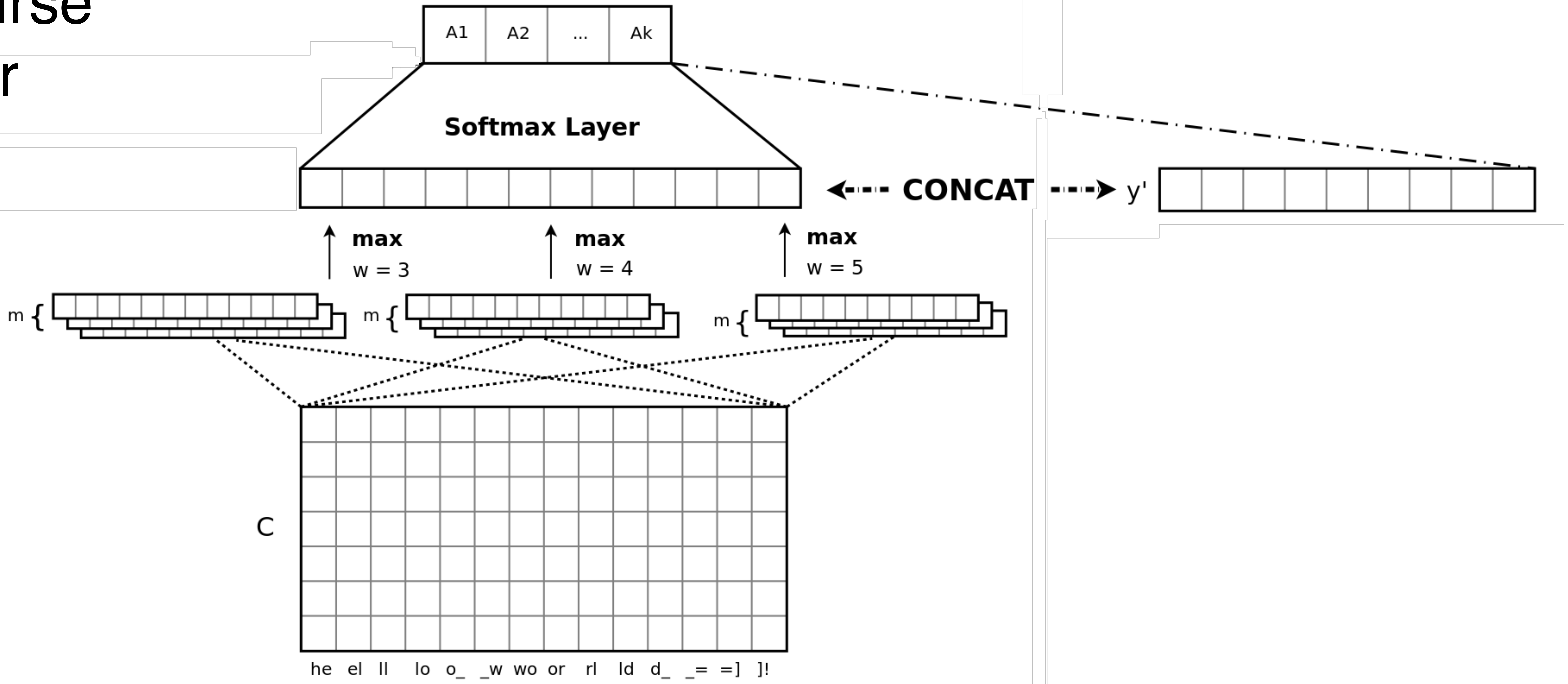
CNN without discourse



Ruder et al., 2016; Shrestha et al., 2017, Sari et al., 2017

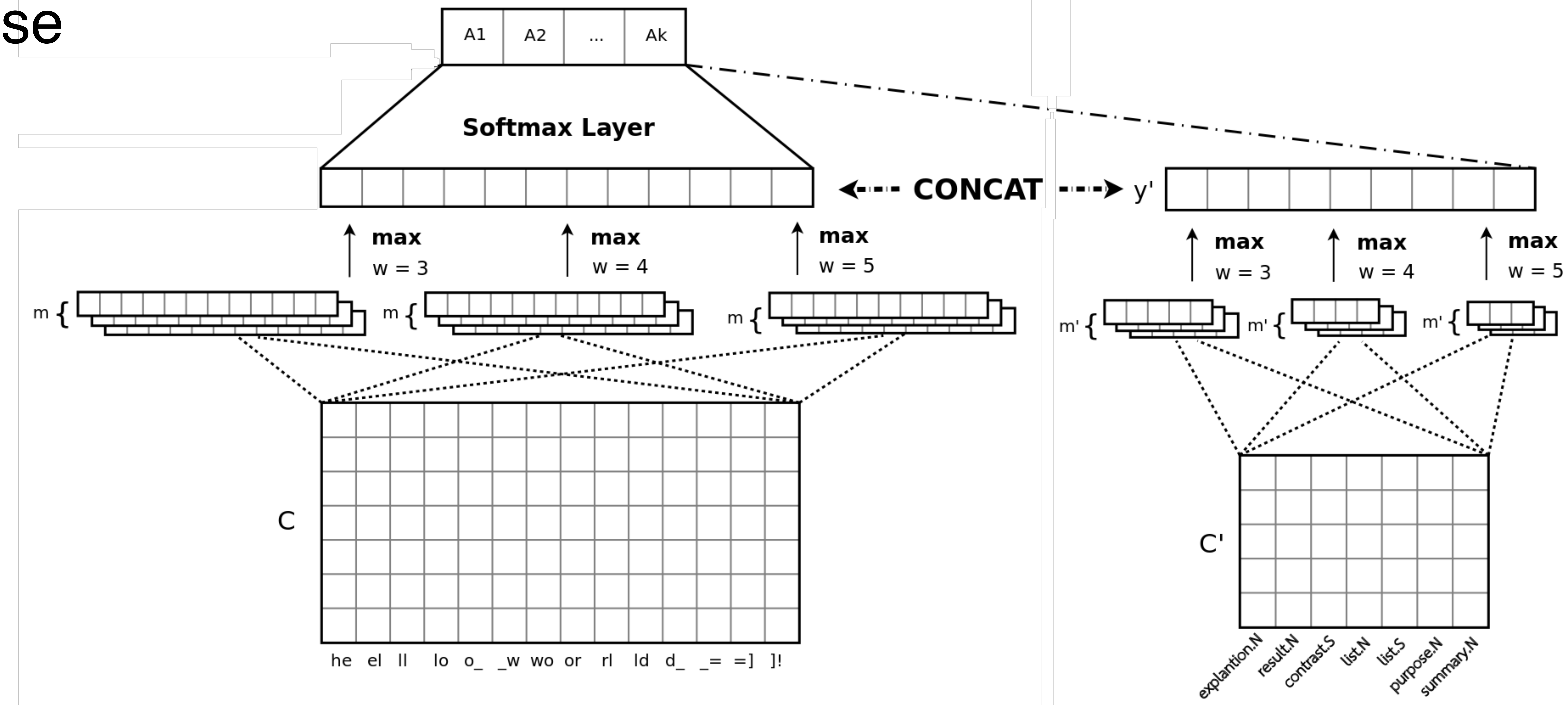
Q2: How can you *integrate* discourse information into the network?

CNN with discourse probability vector



Q2: How can you *integrate* discourse information into the network?

CNN with discourse embeddings

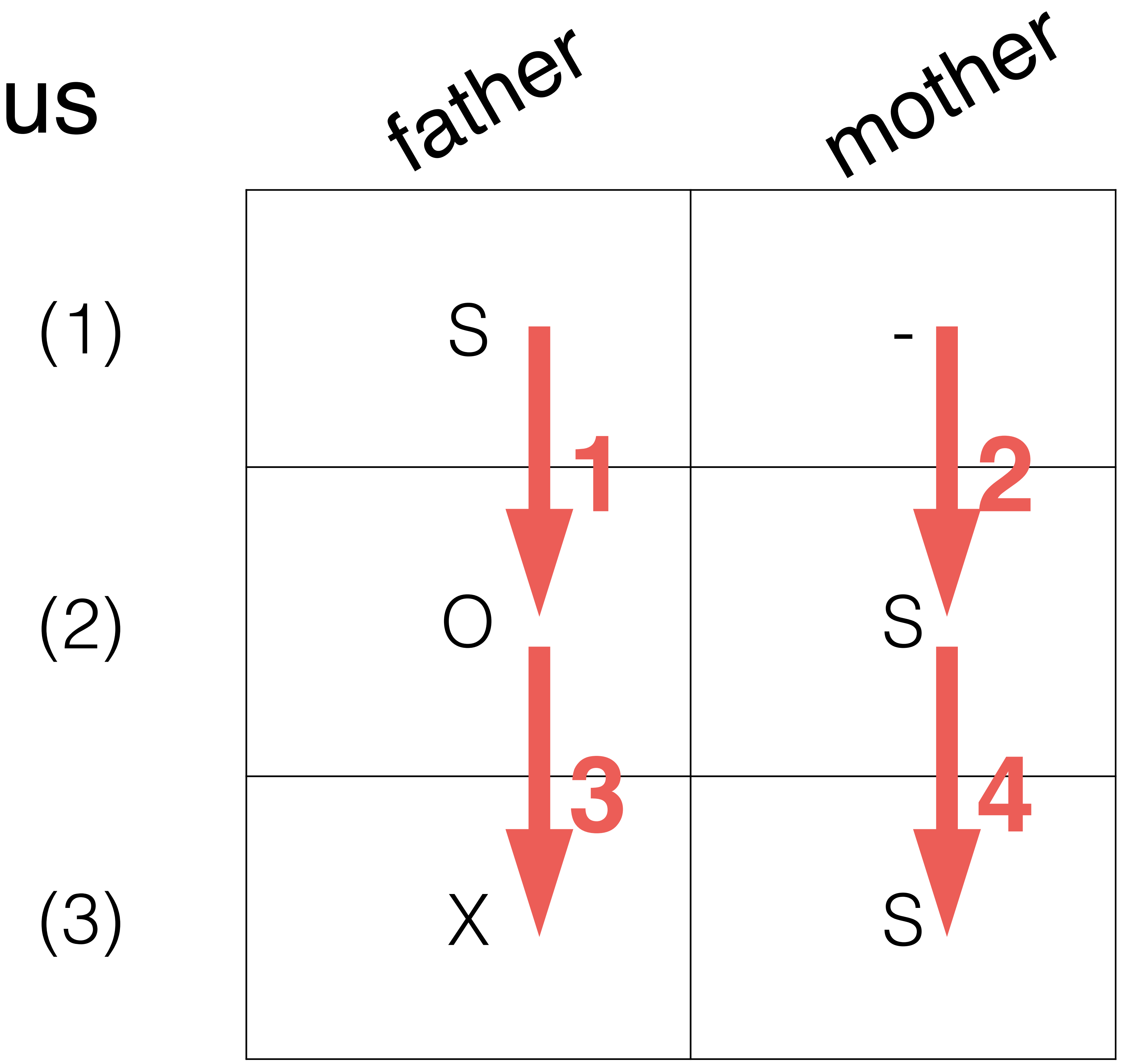


Q2: How can you *integrate* discourse information into the network?

- Use embeddings
  - Local vs. Global
  - Local: how are entities changing across **contiguous** sentences?
  - **Global**: how is each entity changing across a **document**?

Q2: How can you *integrate* discourse information into the network?

Local: by contiguous sentences

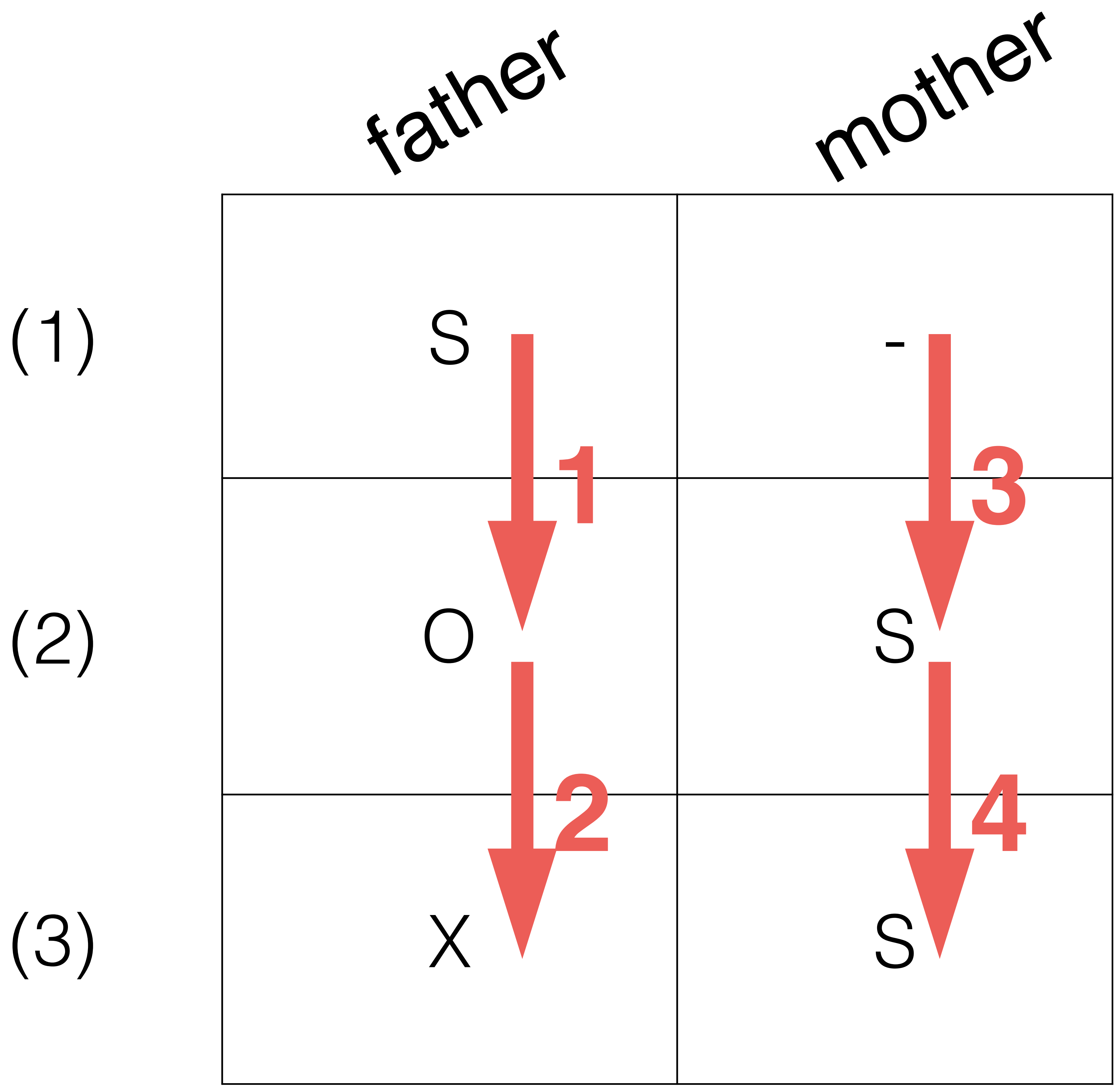


	father	mother
(1)	S	-
(2)	O	S
(3)	X	S

Sequence: so, -s, ox, ss

Q2: How can you *integrate* discourse information into the network?

Global: by entity



	father	mother
(1)	S	-
(2)	O	S
(3)	X	S

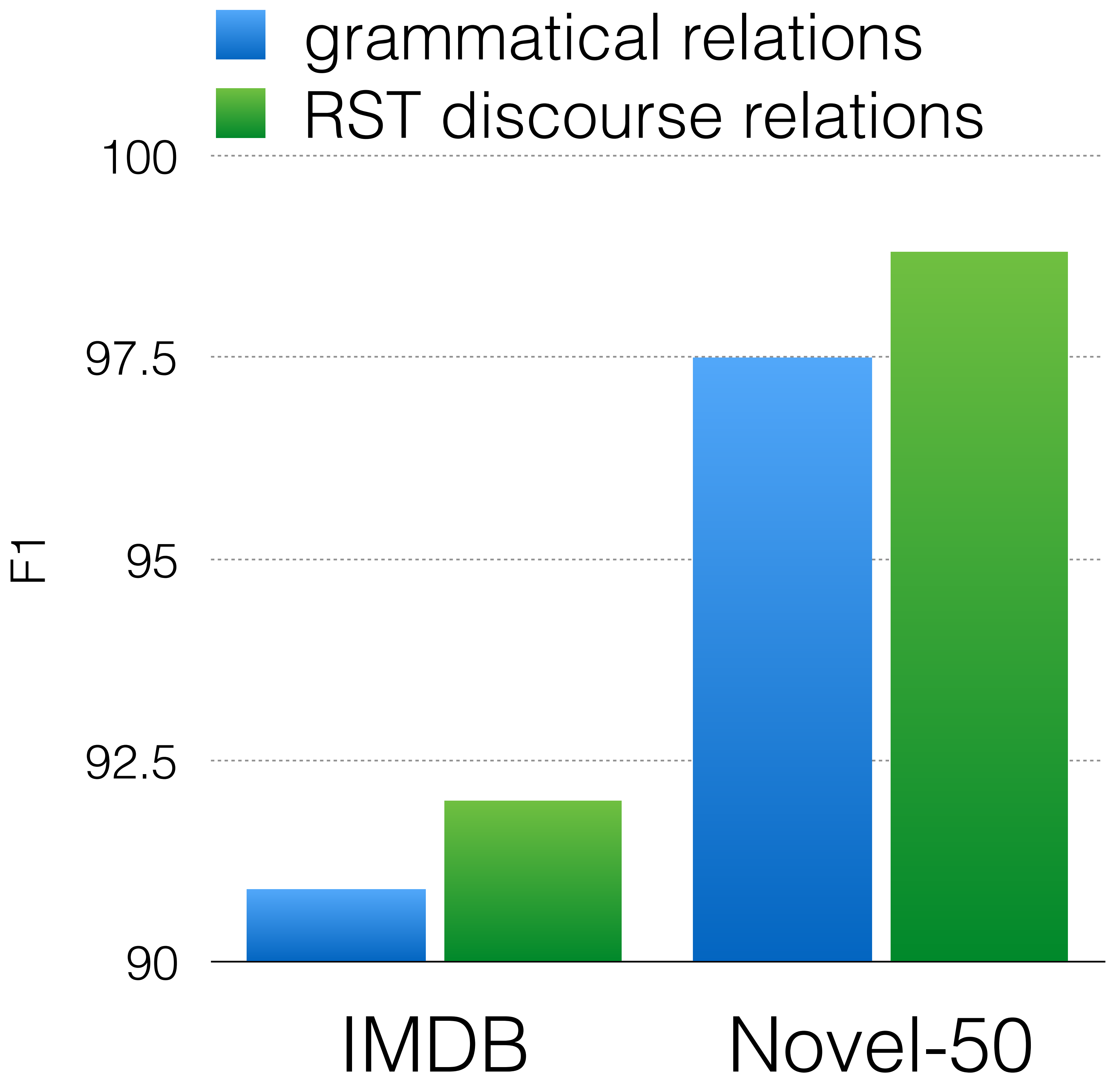
Sequence: so,ox, -s, ss

The University of Texas at Austin

Datasets

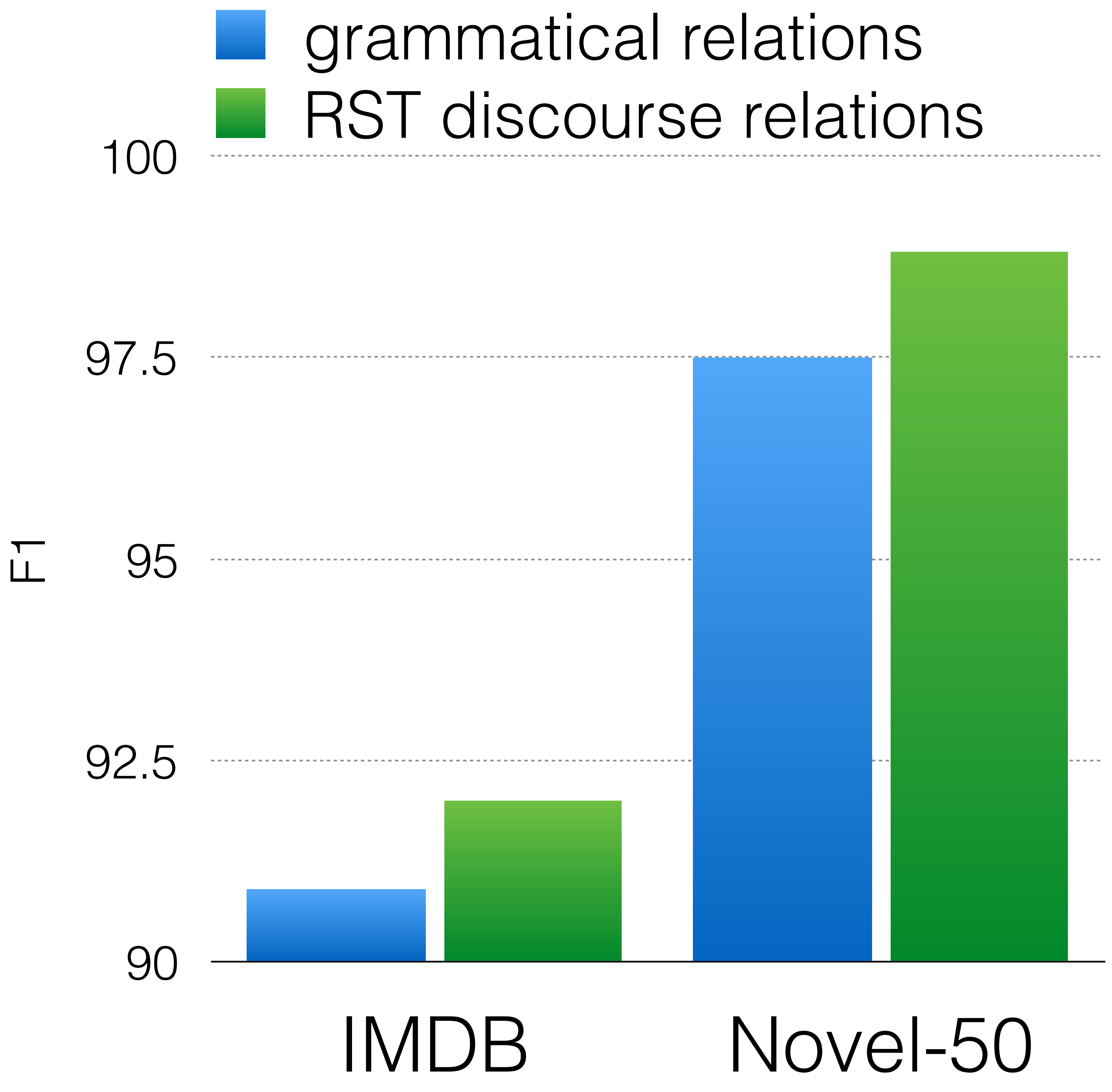
Dataset	# authors	mean words/ auth	mean words/ text
IMDB62	62	349,004	349
Novel-50	50	709,880	2,000

Results



1) How to *featurize*?
grammatical relations
vs.
RST discourse relations

Results



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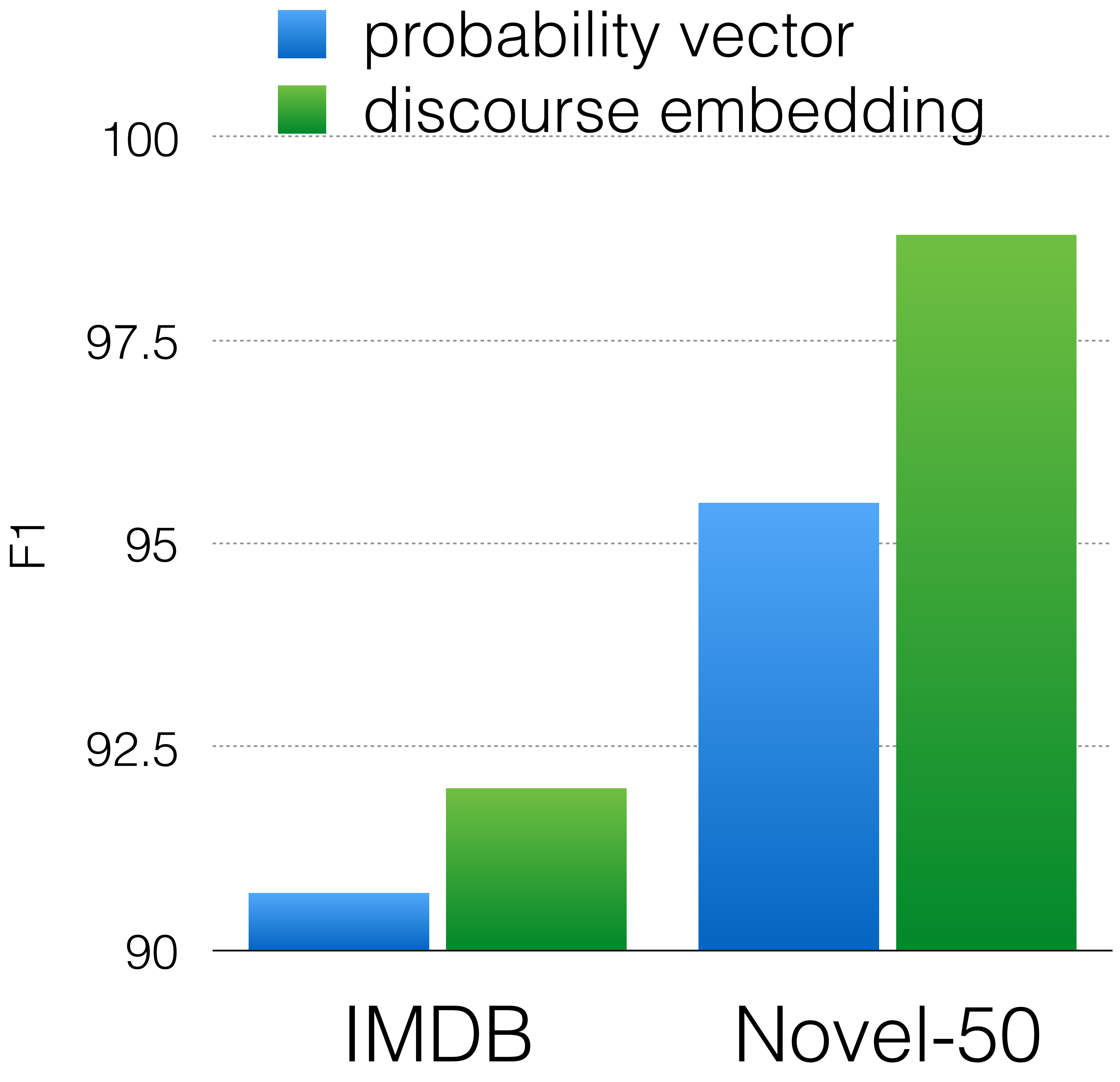


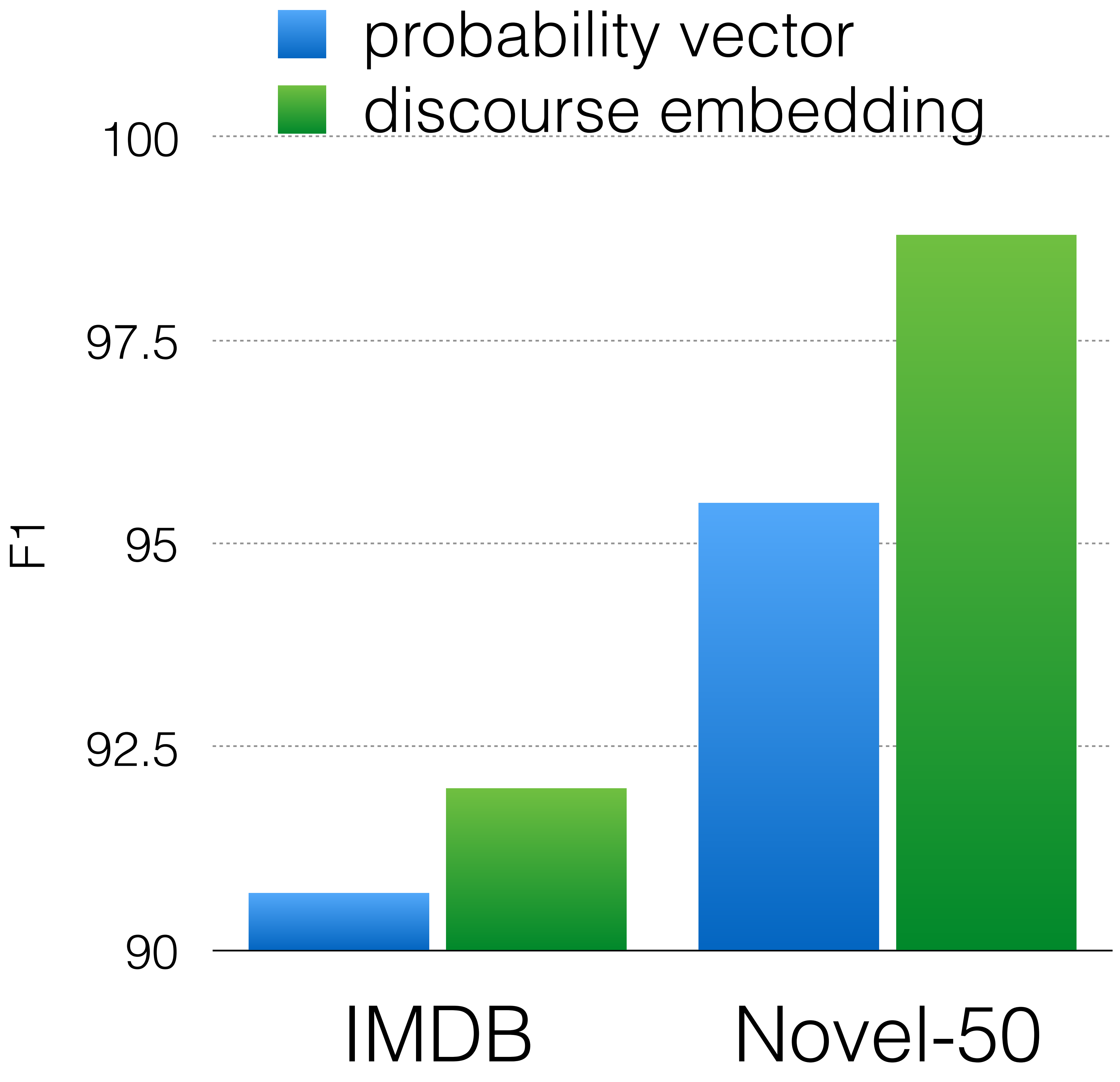
2) How to *integrate*?

probability vector

vs.

discourse embedding

Results



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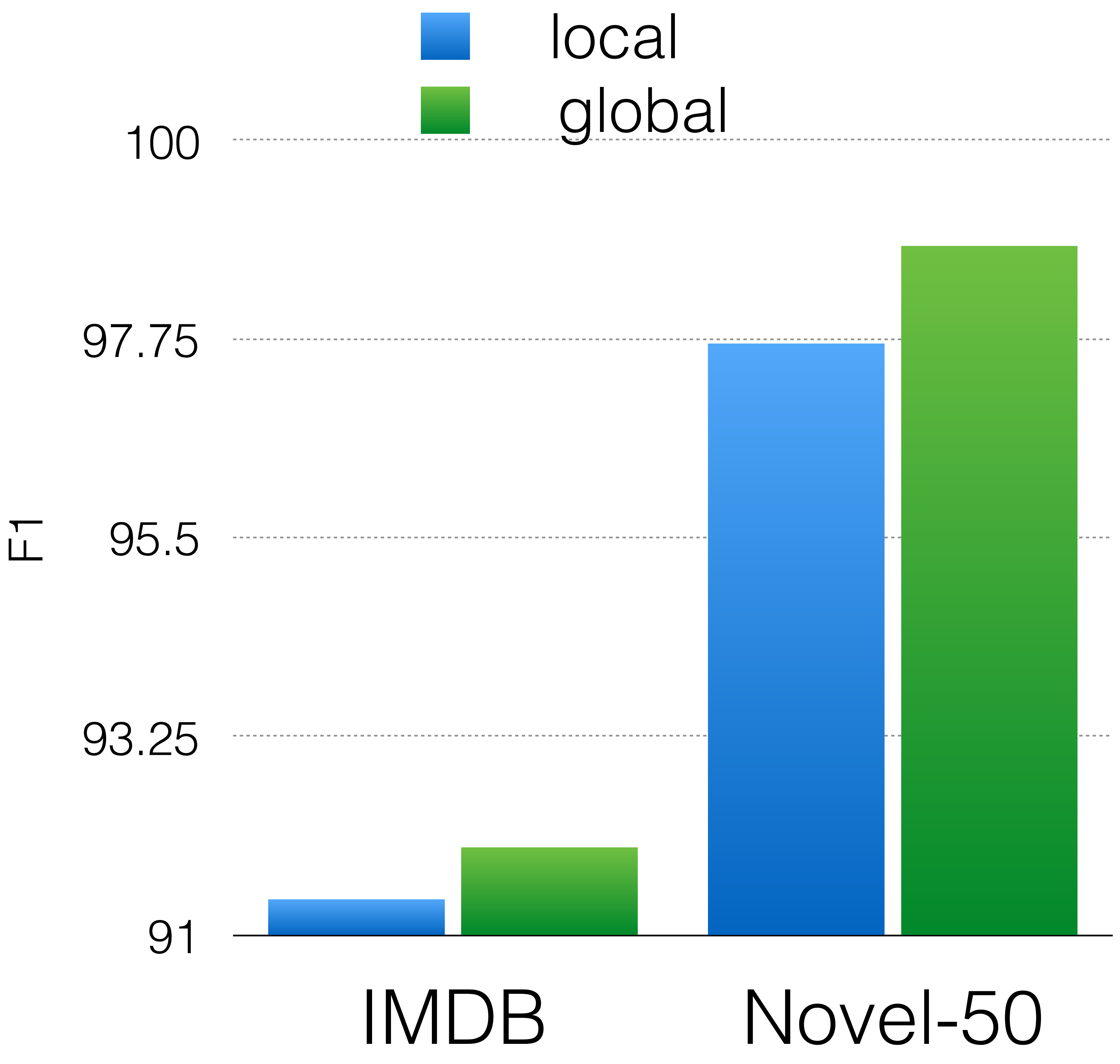
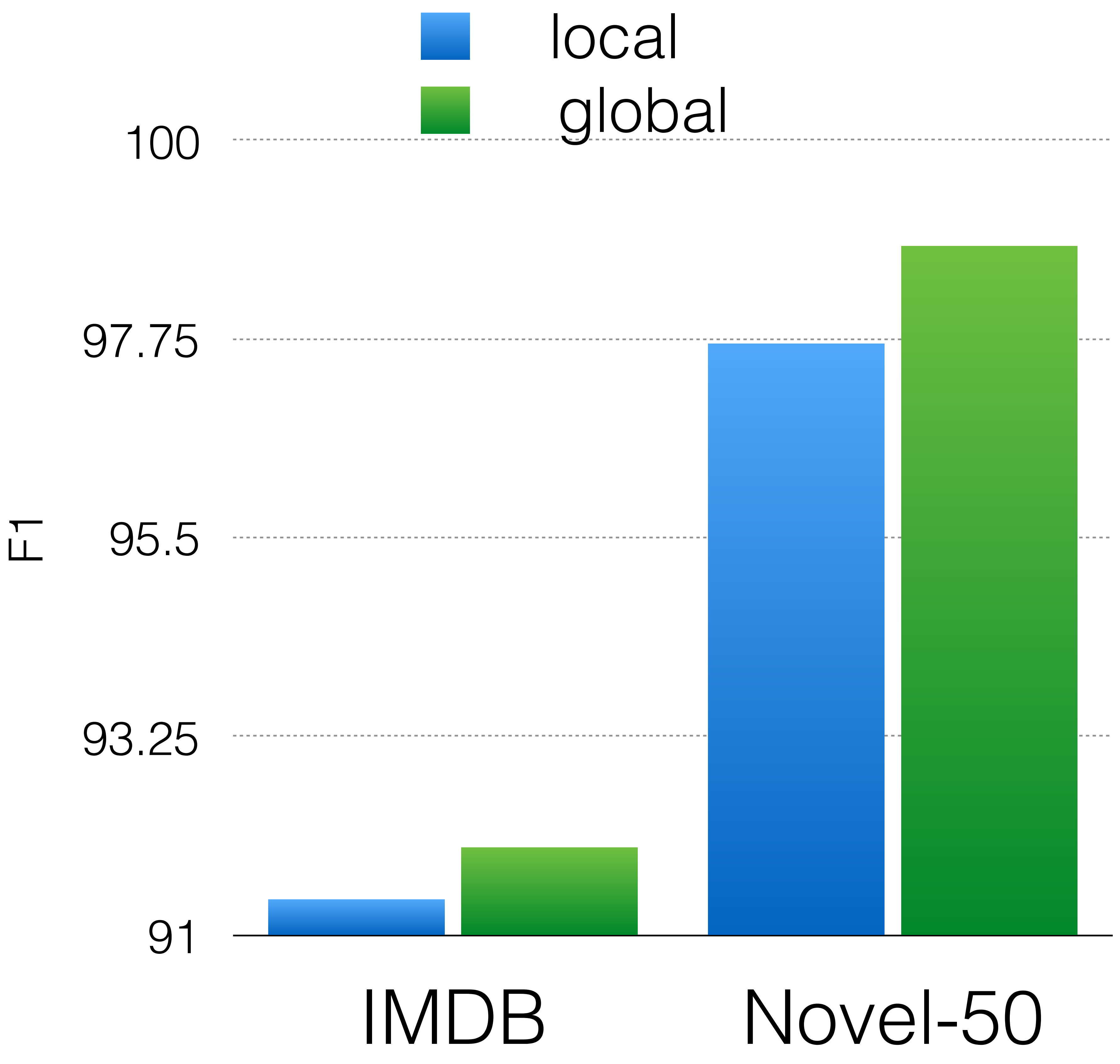


2) How to *integrate*?
local
vs.
global

Results



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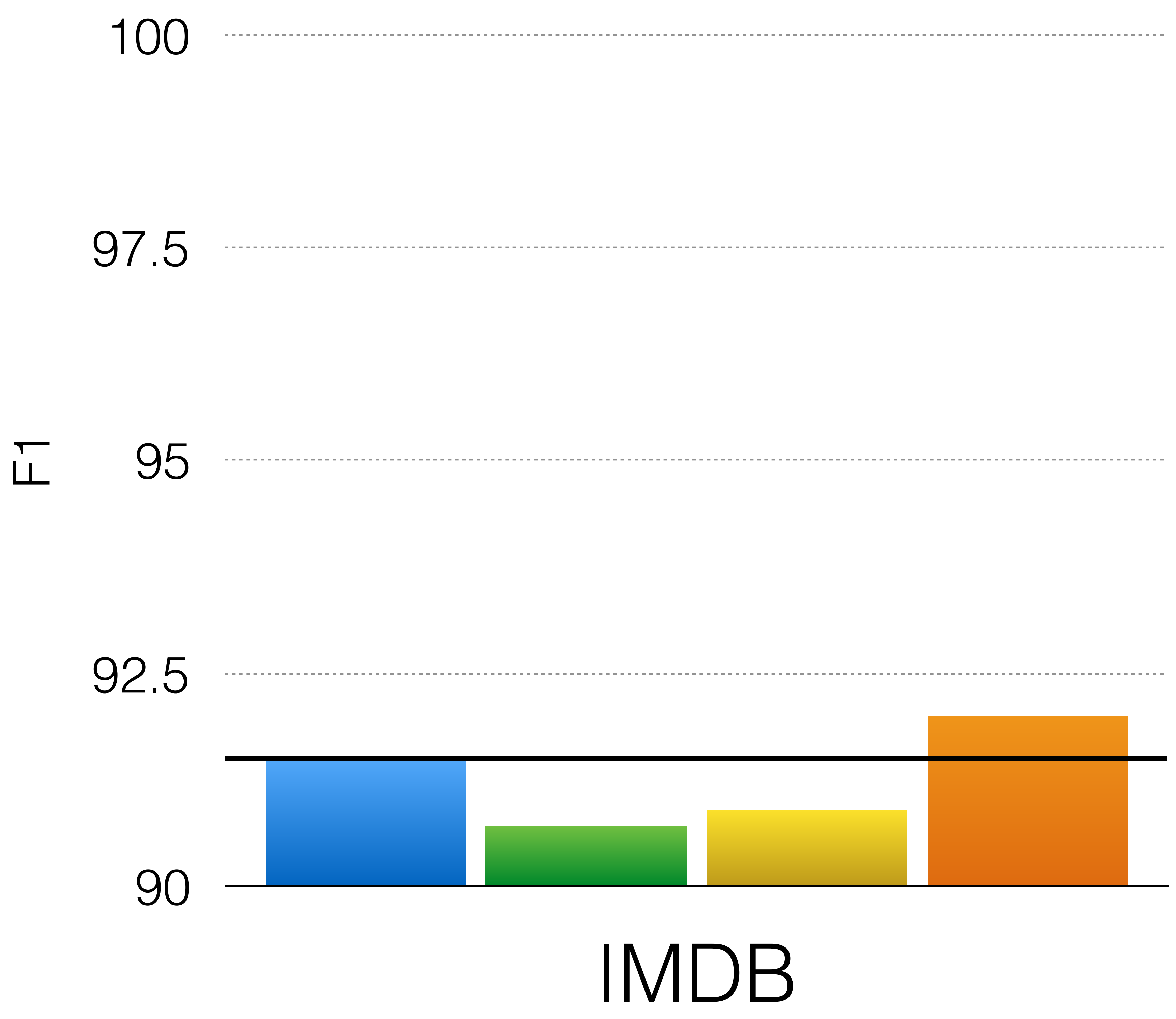
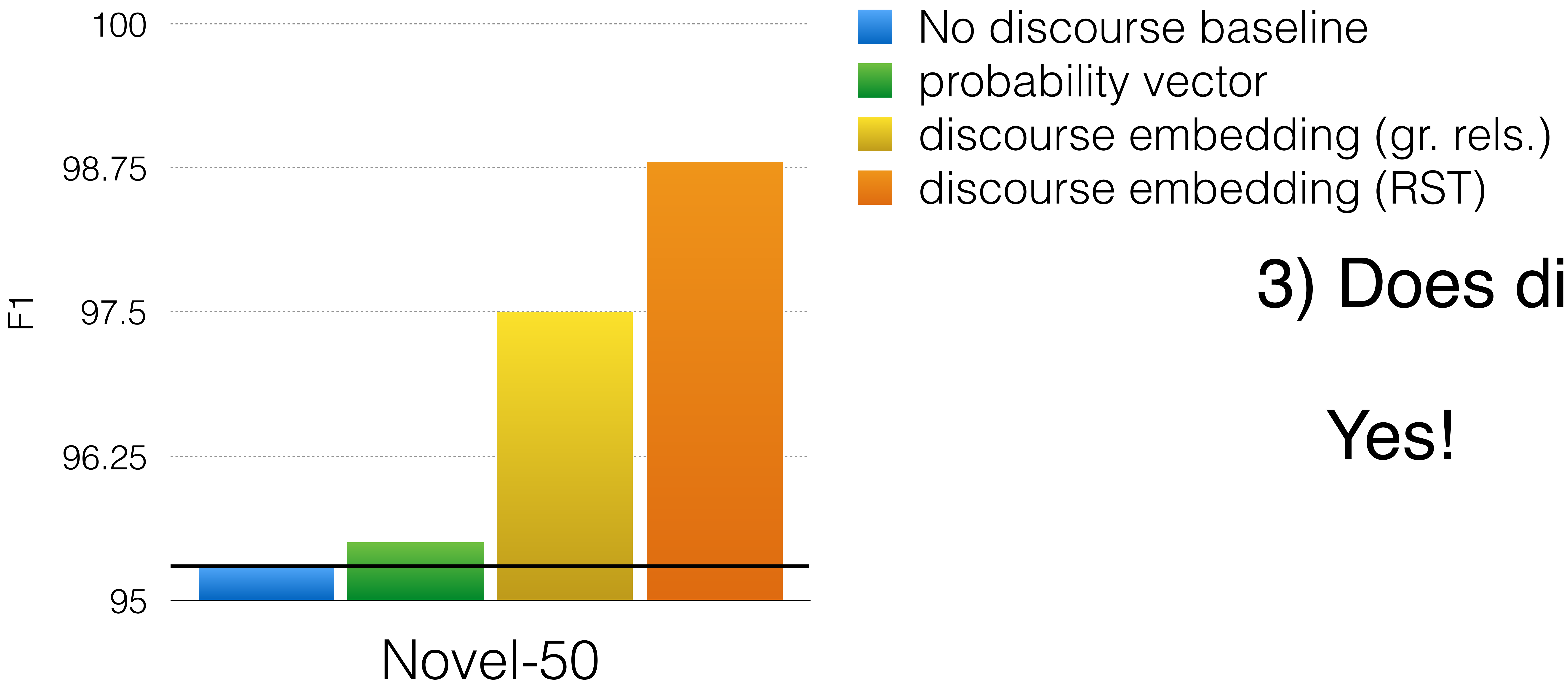


3) Does discourse help?

It depends…

Results



3) Does discourse help?

Yes!

Error Analysis

- The least-represented author (Ambrose Bierce) obtains the biggest improvement from discourse:
    - —Discourse feature is more **robust** with smaller, fewer samples compared to character bigrams
- Two authors who gained large improvements from discourse wrote a variety of genres (e.g., both supernatural horror and love stories)
    - —Character bigrams can't generalize well to the different vocabularies, but discourse captures the similar rhetorical style

Conclusion

- Discourse **improves** authorship attribution over a strong baseline of character-level CNN
- Embeddings of RST discourse relations at the global level perform the best
- Works better on longer documents

Thank you!

Leveraging discourse information effectively for authorship attribution

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