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…”

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

*Lolita*, Nabokov

*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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(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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|    | father | mother |
|----|--------|--------|
| (1)|        |        |
| (2)|        |        |
| (3)|        |        |

row: sentence  
column: salient entity

Barzilay and Lapata (2008)
Q1: How can you *featurize* discourse information?

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(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 \textit{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
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|     | 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!
Q2: How can you \textit{integrate} discourse information into the network?

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

![Diagram](image)

Sequence: so, ox, -s, ss
## 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

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

![Bar chart showing F1 scores for IMDB and Novel-50 datasets with blue and green bars indicating grammatical relations and RST discourse relations respectively.](image-url)
2) How to *integrate*? probability vector vs. discourse embedding
Results

2) How to integrate? probability vector vs. discourse embedding
2) How to integrate?
local vs. global
Results

2) How to integrate? local vs. global
3) Does discourse help?

It depends…
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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