Real-World or Hypothetical Person? Building a Pipeline for Analyzing Gendered Person Mentions in Educational Text

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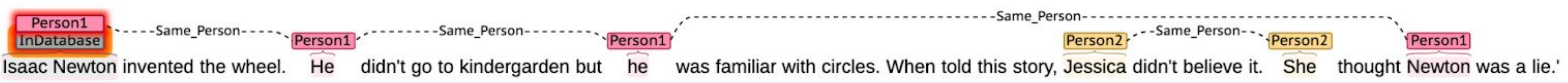
Motivation & Task

- Motivation: Analyzing gender bias in educational textbooks
    - Do the authors introduce gender bias to the text through hypothetical person mentions?
- Task: Identify real-world and hypothetical person-mentions and the genders associated with them.
- Biggest challenges
    - The same person can be mentioned multiple times
    - Identifying a real-world person can be difficult
- Our solution to address these challenges
    - Count all mentions of the same person as one person
    - Use a database to check person names



Person1: Isaac Newton → real-world mention, *Person2*: Jessica → hypothetical mention

Data

Textbook data

Science textbooks:

Elementary school **10 textbooks**

Middle School **23 textbooks**

High School **8 textbooks**

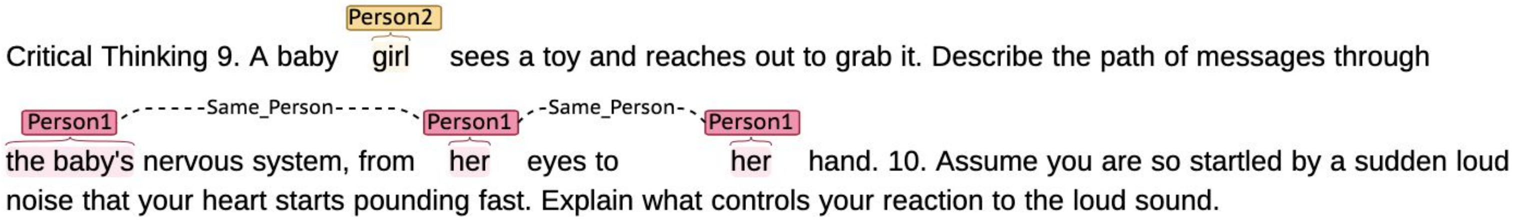
Non-Science texts:

Grade K-8 **9 textbooks** (history)

High school **2 textbooks** (history and economics)

Total number of items: 33,575

Example of an item:



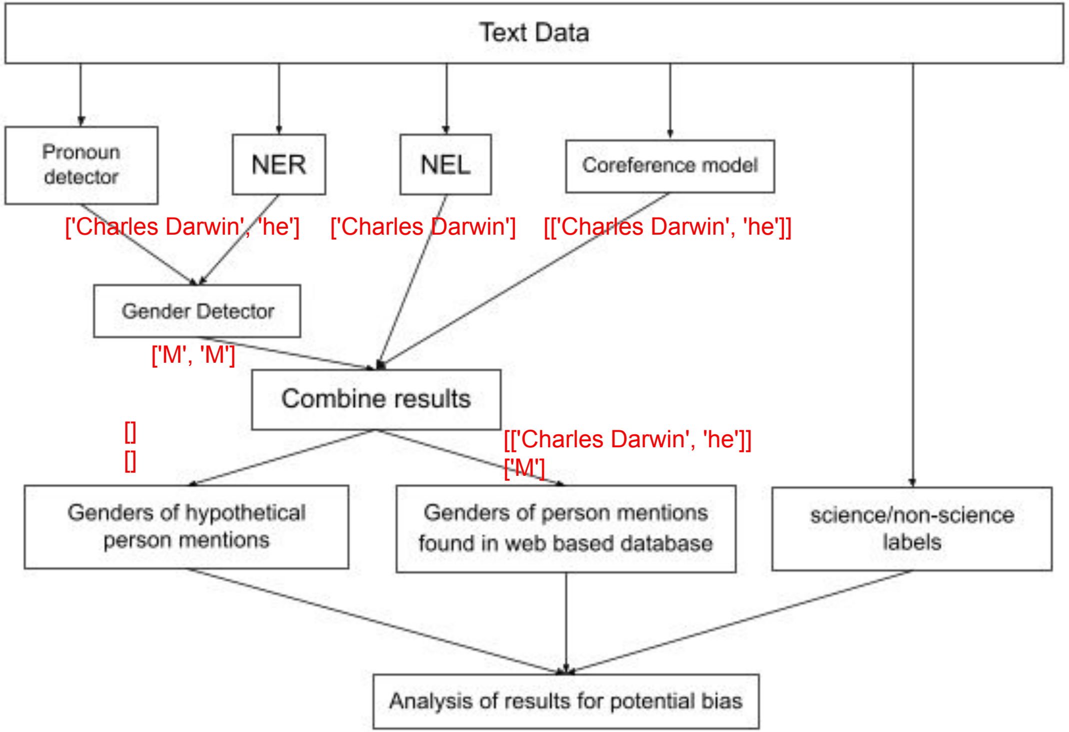
Overview of the approach: Pipeline

Text passes through five models:

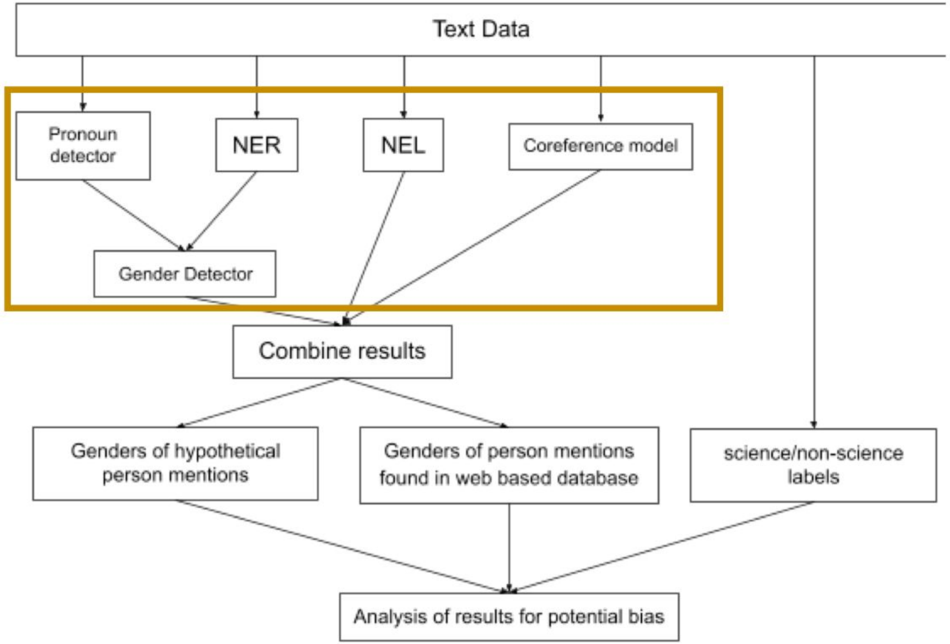
- Pronoun detector
- NER (entity recognition)
    - Looking for person labels
- NEL (entity linking)
    - Looking for person labels
- Coreference model
- Gender detector

Results are combined with the science/non-science labels to generate final analysis.

Check Your Understanding Where did Charles Darwin collect evidence of evolution and what kinds of evidence did he find? What is natural selection? What kinds of traits change through evolution?



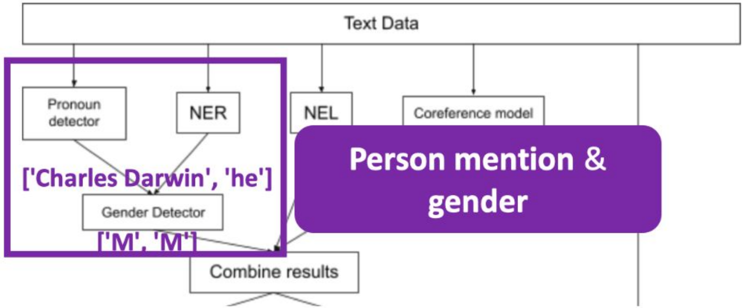
Evaluation



Text Data
Pronoun detector
NER
NEL
Coreference model
Gender Detector
Combine results
Genders of hypothetical person mentions
Genders of person mentions found in web based database
science/non-science labels
Analysis of results for potential bias

Evaluation (part1)

What we are evaluating:



➢ Overall* performance (on detecting person mention)

	Previous work (baseline)		Our pipeline
Precision	78.71%	<	**84.16%**
Recall	83.56%	<	**92.81%**
F-score	81.06%	<	**88.27%**

➢ For <u>male</u> mentions

	Previous work (baseline)		Our pipeline
Precision	84.00%	<	**85.71%**
Recall	65.62%	<	**75.00%**
F-score	73.68%	<	**80.00%**

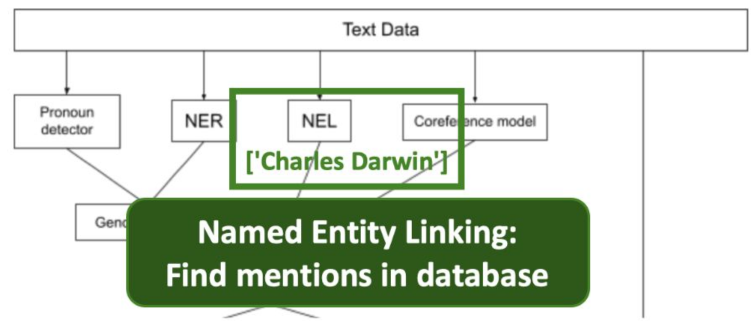
➢ For <u>female</u> mentions

	Previous work (baseline)		Our pipeline
Precision	73.33%	<	**80.00%**
Recall	64.71%	<	**94.12%**
F-score	68.75%	<	**86.49%**

* not considering gender label (F/M/N)

Evaluation (part2)

What we are evaluating:

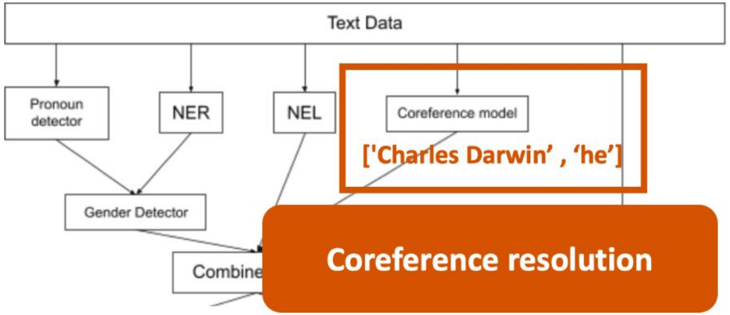


- Hyperparamter: threshold for **similarity score**

Threshold / Metric	0.7	0.8	0.9
Precision	83.71%	87.60%	**89.39%**
Recall	68.42%	**67.80%**	**67.80%**
F-score	75.38%	76.44%	**77.11%**

Evaluation (part3)

What we are evaluating:



➢ Evaluating clusters: B-cubed, mention-based approach

	NeuralCoref* 👍	AllenNLP
Precision	**74.46%**	64.95%
Recall	62.31%	**65.24%**
F-score	**67.85%**	65.09%
Compute time	**1.6s/item (faster)**	9.0s/item (slower)

* By Huggingface

Results and analysis: for **hypothetical entities**

Authors had a choice …

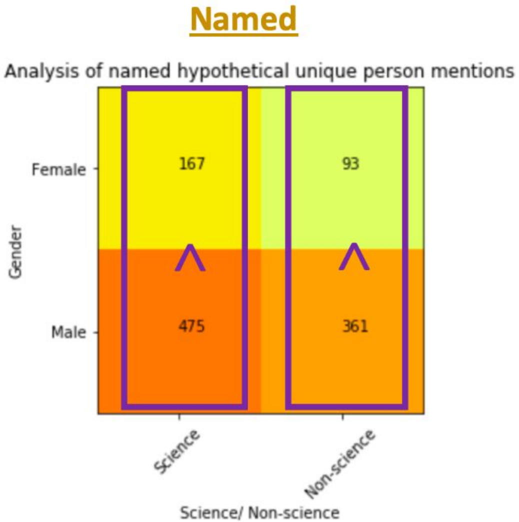
Choice #1

Male or **female** hypothetical entity?

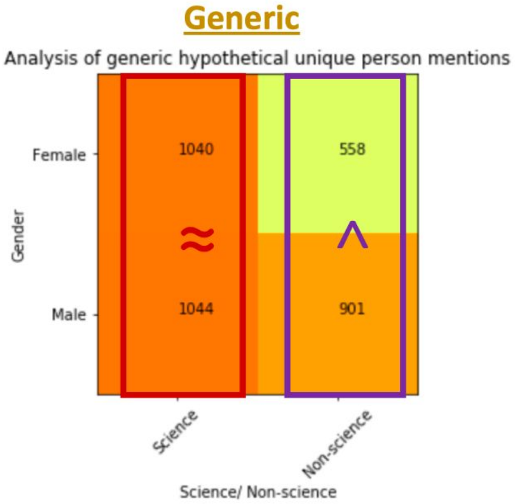
Choice #2

Named (e.g. Sophie) or **generic** (e.g. The girl)?

Results and analysis: for hypothetical entities



Mini-summary #1
Female or **male** hypothetical entity**?**
- **Male entities** appear **more** generally

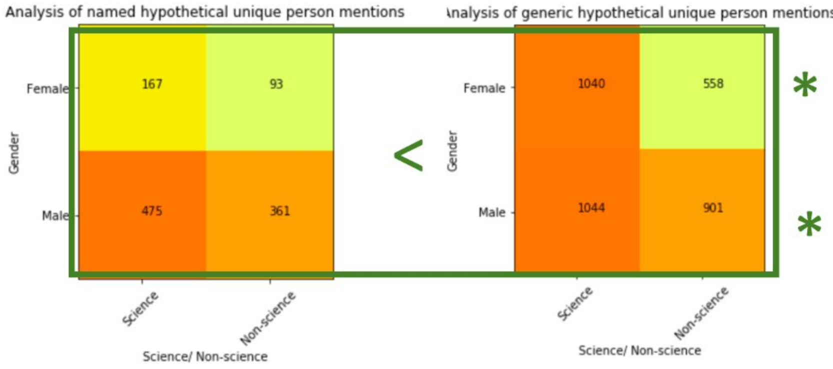


Two-sided binomial test (significance level = 0.05)	*	*	NS	*

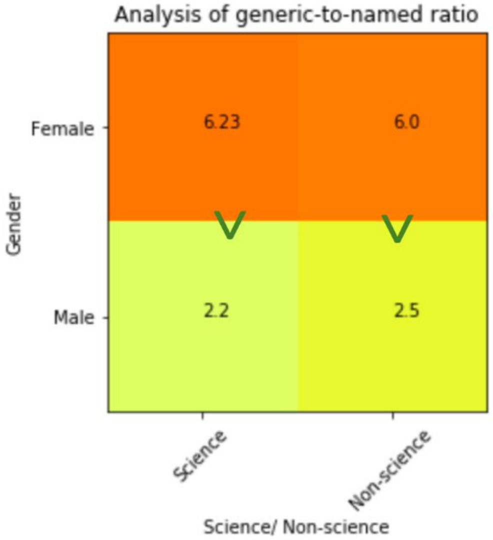
* Statistically significant

Results and analysis: for hypothetical entities

Named **Generic**



Generic : Named



Two-sided binomial test
(significance level = 0.05)

* Statistically significant

Mini-summary #2
Named or generic?
- **Female** more often portrayed as **generic entity**

Results summary for **hypothetical entities**

Bia reflected in …

Mini-summary #1
Female or **male** hypothetical entity**?**
- **Male entities** appear **more** generally

Type of of entities (M>F)

Mini-summary #2
Named or generic?
- **Female** more often portrayed as **generic entity**

How the entities appear