The Effect of Preprocessing on Bayesian Stochastic Blockmodels for Topic Identification

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Overview

1. Approaches to topic identification
2. Bayesian Stochastic Blockmodels
3. Data and Analytical Approach
4. Results

Topic Identification

- Text analysis/NLP
  - Topic modeling (e.g., LDA, STM)
  - Cluster on embeddings
- Network-based approaches
  - One-mode
    - Community detection on semantic networks
  - Two-mode
    - Bipartite community detection
    - Bayesian Stochastic Blockmodels

Bayesian Stochastic Blockmodels

- Why Bayesian Stochastic Blockmodels?
  - Superior performance to LDA
  - Avoid artefacts of single-mode projections
  - Cluster simultaneously documents and words
  - Hierarchical topic structure
- How does preprocessing impact network topology?
  - # nodes
  - # edges
  - Density

How do preprocessing-induced topological changes impact the topics recovered?

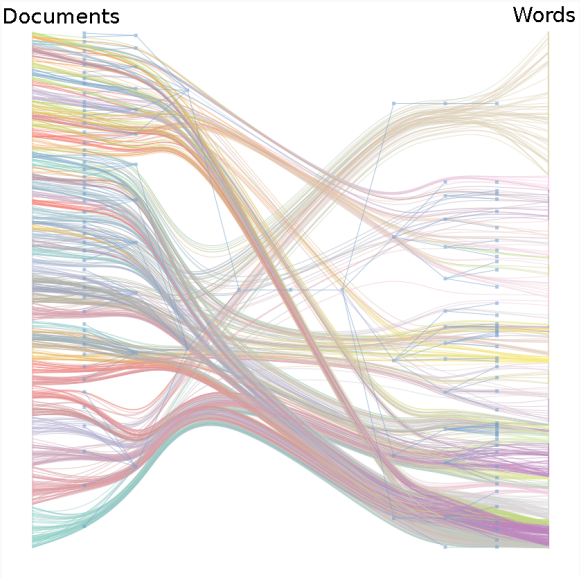
Data and Analytical Approach

- Data
  - Synthetic biology ethics
    - Keyword-based query from Web of Science
    - 15,152 synthetic biology records
    - 574 ethics-related records within this larger set (abstracts used)
  - Education thought leaders
    - List of 1,022 education-related associations, institutions, foundations, individuals curated by education experts
    - 930 Twitter accounts found
    - 1,514,352 tweets from them
    - Randomly sampled 10,000 tweets
- Analytical approach
  1. *Minimum* preprocessing: remove punctuation and case standardization (lowercase)
  2. *Medium* preprocessing: minimum + remove stop words
  3. *Maximum* preprocessing: medium + lemmatize

Results: Synthetic Biology Ethics

Processing: **minimum**
words: 11,970
documents: 574
topic levels: 3

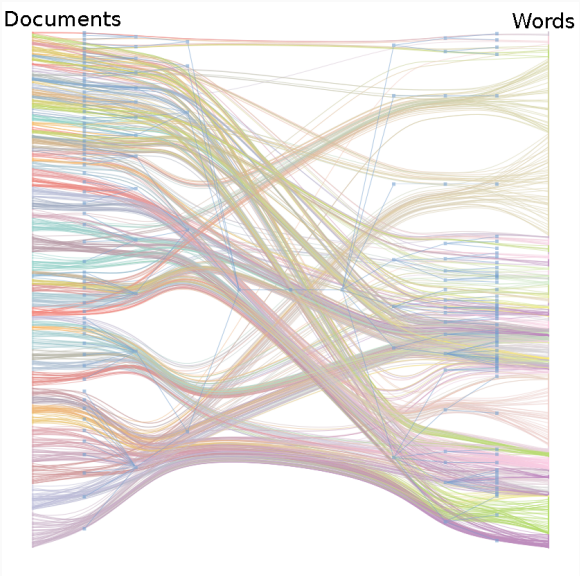
- Level 0: 48 topics
- Level 1: 15 topics
- Level 2: 5 topics



Results: Synthetic Biology Ethics

Processing: **medium**
words: 11,716
documents: 574
topic levels: 3

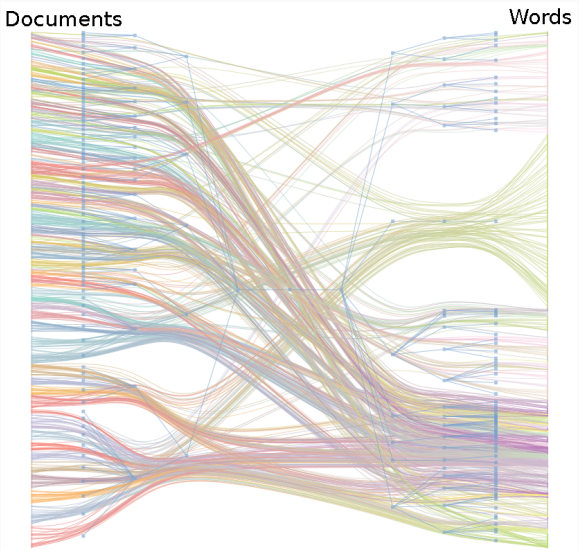
- Level 0: 64 topics
- Level 1: 21 topics
- Level 2: 7 topics



Results: Synthetic Biology Ethics

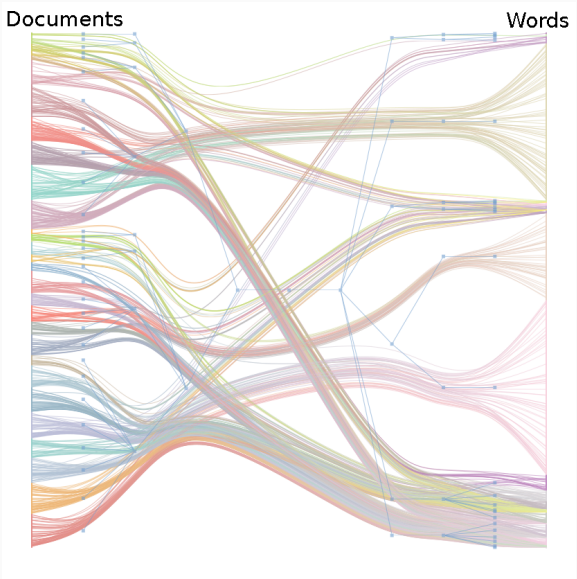
Processing: **maximum**
words: 9,698
documents: 574
topic levels: 3

- Level 0: 77 topics
- Level 1: 23 topics
- Level 2: 8 topics



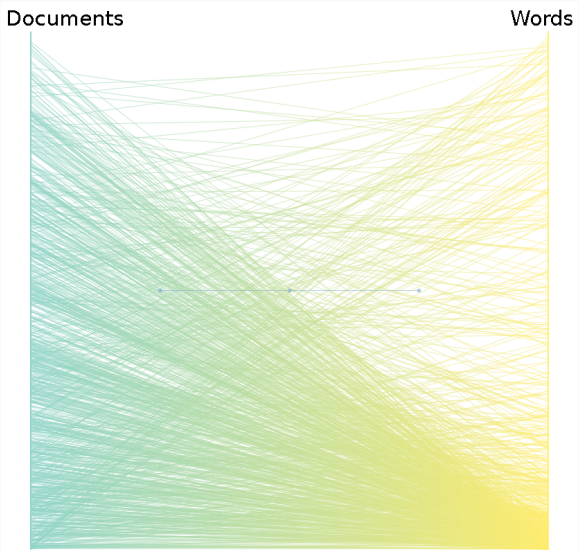
Results: Education Thought Leaders

Processing: **minimum**
words: 43,742
documents: 10,000
topic levels: 3



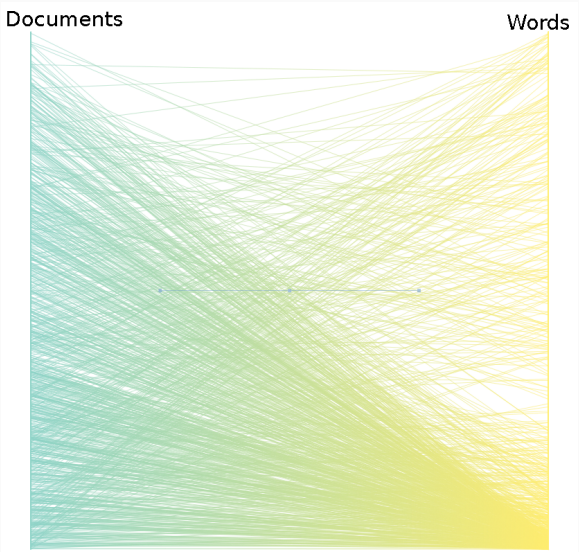
Results: Education Thought Leaders

Processing: **medium**
words: 43,429
documents: 10,000
topic levels: *none*



Results: Education Thought Leaders

Processing: **maximum**
words: 43,429
documents: 10,000
topic levels: *none*



Conclusions

Document type matters!

- Synthetic biology ethics: Longer documents, complex writing
  - Number of topic levels remains constant
  - Change in topics (both number and substance) within levels
  - Minimal change in topic quality
- Education thought leaders: short documents, simple writing
  - Total loss of utility with increased preprocessing

Acknowledgements

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Education thought leaders:
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Thank you!

If you have questions or comments or want to check out the code, do not hesitate to reach out.

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