"ArXiv Unveiled: Analyzing Metadata on Scientific Papers"

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Introduction

Welcome, brief overview, problem statement

Who is Data Analyst Think Tank?

“We are a fictional cutting-edge research consortium dedicated to advancing scientific insights through rigorous data analysis. Focused on unraveling the complexities of research articles stored at ArXiv, our team employs state-of-the-art analytical methods to extract valuable patterns and trends, contributing to the evolution of scientific knowledge. As the forefront of data-driven research, we aim to bridge gaps in understanding and propel innovation within the scientific community.”

"This autogenerated mission statement encapsulates the core of our mission."

Problem Statement (preliminary study)

- "Can we predict which research field a scientific article is in, based on its abstract alone?"

- Why?
  - Efficient literature reviews
  - reading recommendations for scientist
  - targeted outlets for articles

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Dataset

And data cleaning

1.1TB & growing

(original ArXiv data)

about 3.69 G

1 big Metadata JSON

~= 100M

50K line JSON subset

Dataset Paring & Cleaning choices

- downloaded the 3GB JSON file
- split into approx 48 (50K line) chunks with a shell script
- working with a single chunk for this study
- dropping rows tagged in multiple "categories"

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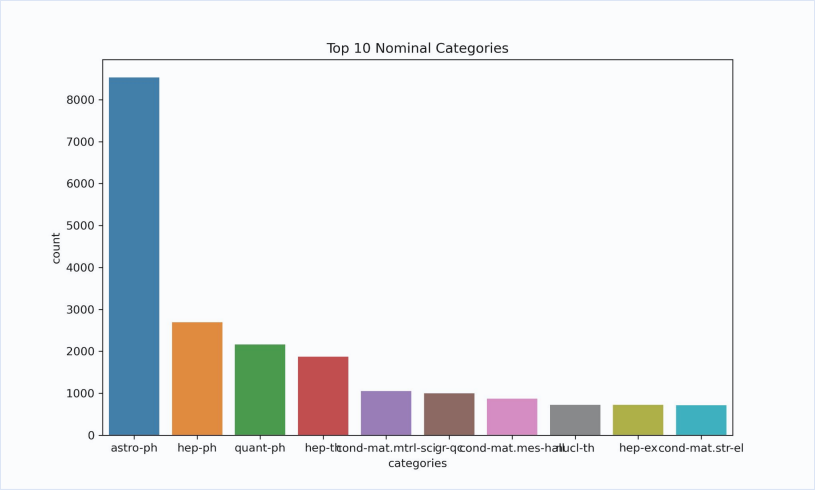
Preprocessing & EDA

Preprocessing & EDA

- dropping unneeded columns,
  - minimum number of samples per class (dropping more rows)
  - lowercased abstracts
  - normalizing counts in target column
- Steps taken in preprocessing that went unused for now
  - Label Encoding (changing the category column to number identifiers)
  - Manually adding numeric features that I thought might be interesting (took too long on 30K rows by ~100-200 words)
  - Manually Tokenizing, removing Stopwords



Key Findings

- 120 unique categories in this data (that's a lot to Vectorize)
- Extremely unbalanced: most are Astrophysics
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Model Construction & Evaluation

- Baseline/benchmark prediction: the "most common" class
- Preliminary study design is based on our NLP Lesson 2
    - Pipelining a simple CountVectorizer, & one basic (Multinomial Naive Bayes) model, into a GridSearch
- Simple Preliminary Models, for fast/intuitive answer for clients

- Evaluation metrics and criteria

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Results so far?

Not ideal

Results

Answer to the question: Yes, but not well.

- We'll be right about 26% of the time, with the baseline prediction, due to original dataset imbalance
- This can’t be guaranteed over all data chunks, or future research imports.

NLP Model, as is, did not provide useful results

Next Steps before Project Expansion

- need to fix code errors
- Recommend grouping categories into "most common ten" vs "other", to binarize the prediction and speed up results

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Suggestions for Future Improvements

Suggestions for Future Improvements

- entire 3GB metadata dataset for better training
  - (or at least better sampling across chunks)
- using the fulltext of the articles
- considering more features than just NLP on 1 field:
  - columns I dropped, or NLP on title / fulltext
  - Time-based information (publication date)
- external datasets for context (info on authors)
- Models! I'd like to include/tune Random Forests because I'm working on categorical predictions

Thanks!

Do you have any questions?

Thanks especially to my classmates in this cohort, to my instructors Tim & Rowan, to our outcomes instructor Brigid, and to Kay for additional support!