Case Study: The Cybernetics Thought Collective's experiments with AI tools to determine community provenance and create archival metadata

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Educational applications: This case study can be used as a motivator when discussing Natural Language Processing (NLP) and how it can be used in archives and records management. It also explores the more abstract relationship between AI applications in archives and the concept of community provenance. Additionally, this case study is valuable for explaining basic algorithmic thinking in the form of ML pipeline tasks, and highlights the need for basic data science skills when working with AI/ML. This creates spaces for discussion about computational archival science, and its role in working with AI in archives and records management. Furthermore, it also raises questions about the overall trustworthiness of machine-created data, and illustrates how large datasets, like those held in archives or created by AI applications, still face challenges with data visualizations.

Educational topics: Natural Language Processing (NLP) in archives, AI/ML for arrangement and description, reliability and accuracy of AI-created metadata, visualizing and datafying data[2].

About: This case study is part of a series of learning materials developed by InterPARES Trust AI[3] researchers and educators to train archival professionals and students to effectively leverage artificial intelligence in their archival work. The final draft was completed on October 21st, 2023. It has a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International BY-NC-SA 4.0 license, which requires that reusers give credit to the creator. It allows reusers to distribute, remix, adapt, and build upon the material in any medium or format, for noncommercial purposes only. If others modify or adapt the material, they must license the modified material under identical terms.[4]

This case study investigates the Cybernetics Thought Collective: A History of Science and Technology Portal (CTC) Project's experiments with machine learning and natural language processing to reveal connections between fonds through generated data. This pilot project aimed to use AI tools to reveal connections in and between corpora of records with overlapping archival bonds and find computational ways of determining how documents are primarily related to one another.

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[2] Educational applications map to a Body of Knowledge proposed by InterPARES researchers for AI/ML for the archival professionals. https://docs.google.com/document/d/1UsjkkkGeSJrgCDJGASCAy5q0uo_ZkQpzi_Ch8XUcqYw/edit?usp=sharing

[3] This case study is an outcome of InterPARES Trust AI, an international research partnership led by Drs. Luciana Duranti and Muhammad Abdul-Mageed, University of British Columbia, and funded by the Social Sciences and Humanities Research Council of Canada (SSHRC). https://interparestrustai.org/

[4] Case Study: The Cybernetic Thought Collective's experiments with AI tools to determine community provenance and create archival metadata

Between 2017 and 2019, the CTC was an international collaborative research project experimenting with computational archival approaches to the fonds of the four founding fathers of cybernetics: Heinz Von Foerster, W. Ross Ashby, Warren S. McCulloch and Norbert Weiner. While exploring their correspondence networks to shed light on the records' provenance, the project also sought to illustrate how cyberneticians formed and transmitted their ideas collaboratively. Given the project's scope, the CTC researchers only selected a portion of the materials from each of the four fonds, which were then digitized to the folder or item levels, depending on the individual record's complexity. The records were subsequently made machine-readable and computable as data through a process of text normalization. This process included the development of a controlled vocabulary based on word frequencies in a comprehensive collection of essays on cybernetics to train the algorithm to recognize cybernetics entities and concepts. Once the records were prepared for computational analysis, project programmers developed a pipeline to extract data from the selected records (see Figure 1). This data, which included cybernetics terms and associated names as outlined in the training vocabulary, was used as archival metadata for each file and as inputs for the machine learning classification algorithm for determining connections across and between the selected fonds (See Figure 2).

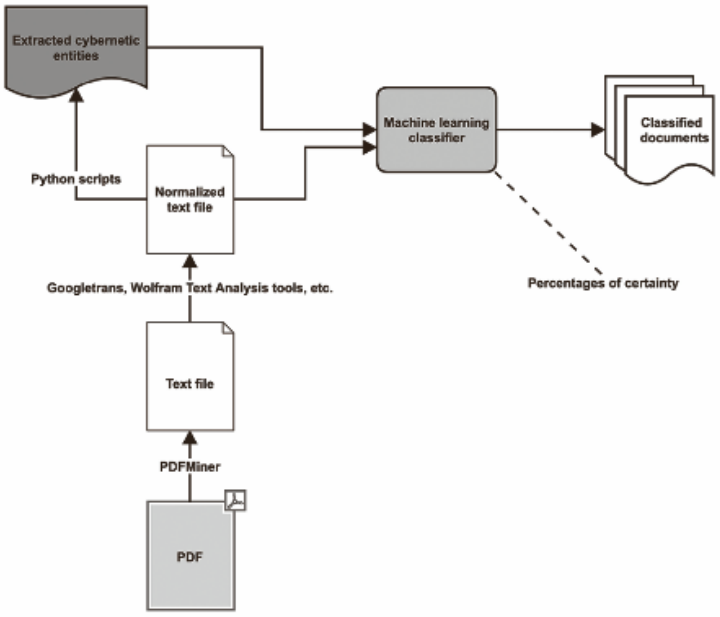

Figure 1: Computational Analysis Pipeline (Anderson, 2021)

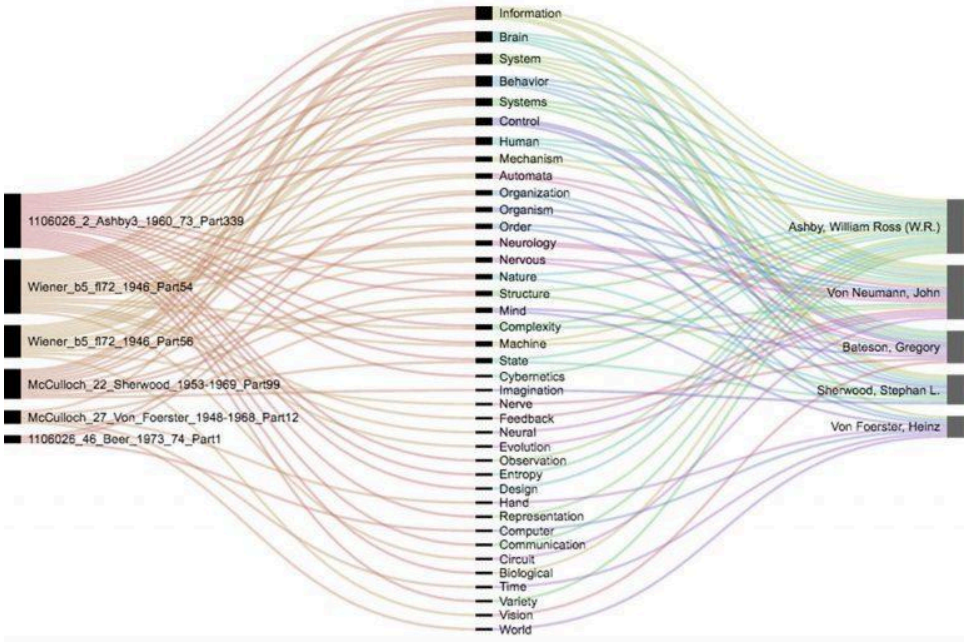

Figure 2: Machine-extracted archival metadata and cybernetic term correlation visualization between correspondents (Cybernetics Thought Collective, n.d.)

The algorithm was trained on a set of 154 documents, which were manually grouped into four categories: mathematics/logic, computers/machines, psychology/neuroscience, and personal. Then, both the previously extracted data and the training set documents were run through the algorithm, which classified the documents and produced statistical probabilities for each category to demonstrate the potential nuance of concepts in each record. The data generated by this workflow was then made accessible through the University of Illinois' front-facing user interface with a specialized profile to accommodate machine-generated metadata. Furthermore, a series of test visualizations were also developed with the hopes of providing insights not easily gleaned from merely browsing the metadata; however, the project team determined that current visualization software cannot handle extreme quantities of machine-generated data and are better suited for simpler datasets. Ultimately, this case study raises questions surrounding the accuracy, reliability and trustworthiness of machine-created data and highlights the importance of continuous refinement of algorithm inputs and training set refinement to better indicate the trustworthiness of data produced by AI.

Potential Discussion Questions:

1. How can machine learning techniques like NLP further contribute to uncovering connections and relationships between archival fonds, and what are the potential limitations of these technologies in archival research?
2. In what ways can AI tools which recognize community provenance among archival fonds challenge the traditional archival assumption of individual creator provenance?
3. Given the challenges faced by the CTC Project in visualizing their large datasets, what are some potential strategies or tools that could improve the effectiveness of data visualization in similar archival or records management projects?
4. Can AI-generated metadata for digital records be classified as paradata? If yes, how does this impact the transparency and credibility of the records? If no, why not?
5. What ethical considerations arise from the use of AI-generated metadata in archives and archival research, particularly regarding the accuracy, reliability, and trustworthiness of machine-created data?

References

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