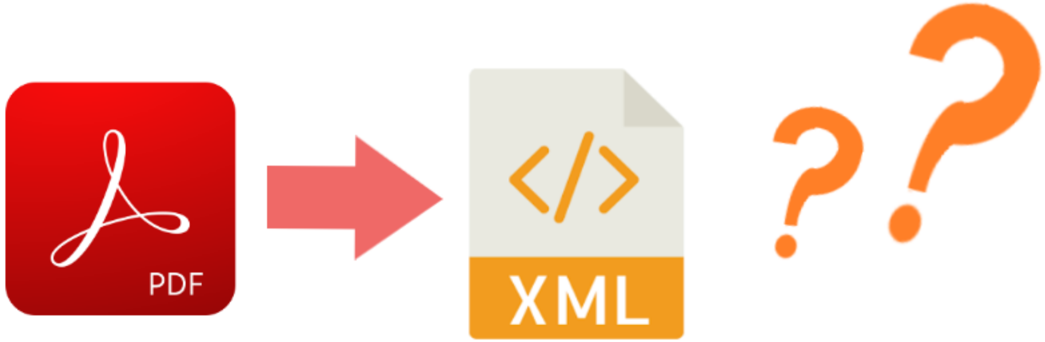
TECHNISCHE
UNIVERSITÄT
DARMSTADT

Index Extraction From Textbooks

KOM Lab Design Workshop – Group KM-2



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Our Project: Index Extraction From Textbooks

Motivation

- Index of a book can contain information about its contents that can be analyzed
- If Index can be extracted it can be used for keyword extraction or algorithmic paragraph headline creation

Problem

- Most Textbooks are PDF
- PDF is not well structured and thus can not easily be interpreted by a machine

Idea

- It’s difficult for a machine to read and contextualize the content of a PDF file
- XML is well structured with labels

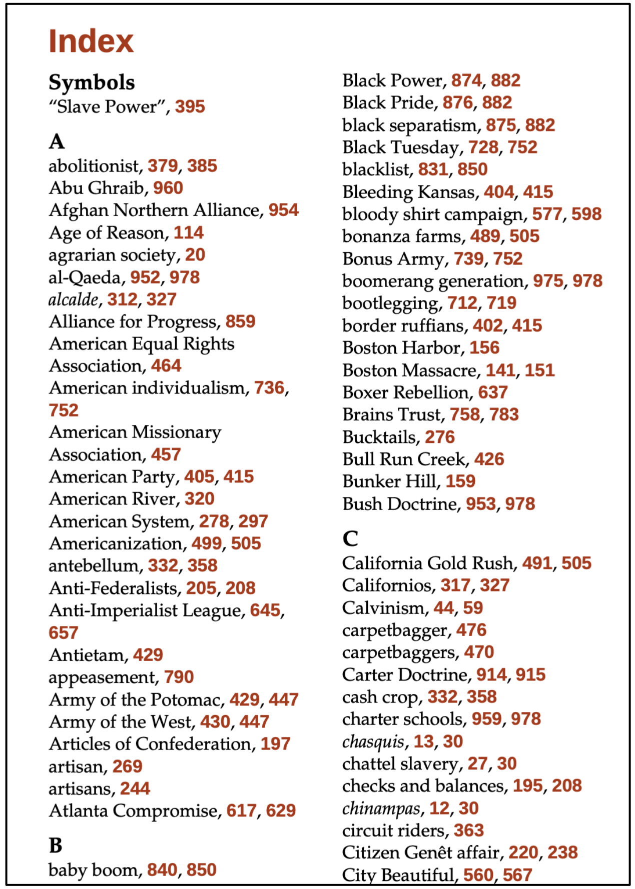
Solution

- Automate index extraction from PDF files to standardized XML files

Existing Related Projects and Services

Amazon Textract	• AWS cloud based service to extract data from scanned documents using machine learning • Made for scanned documents that do not contain actual text • Expensive and not open source
Apache Tika	• Java based toolkit to parse PDF Documents and it‘s metadata and extract into HTML format extraction • Powerful toolset
PDFBox	• Open Source Java Library • Powerful toolset • Well documented and integrated into Java

Implementation Idea: Intermediate Format



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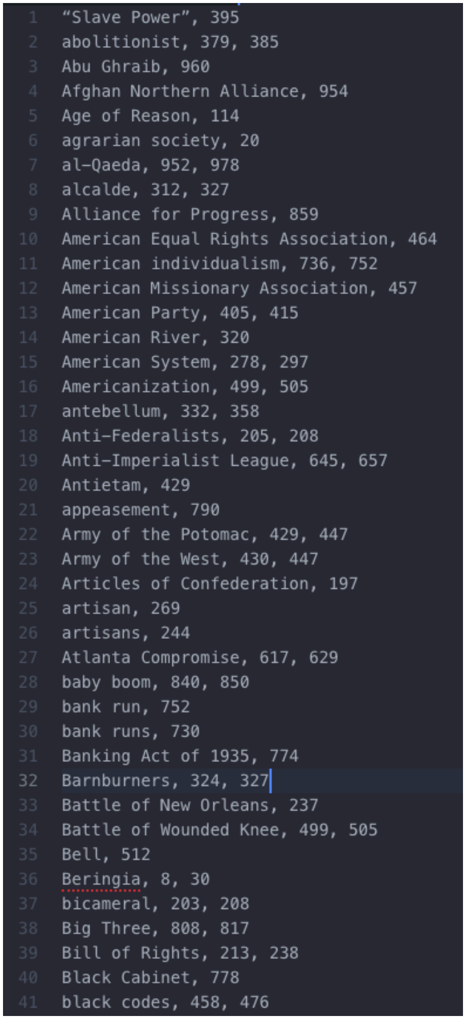
Step 1



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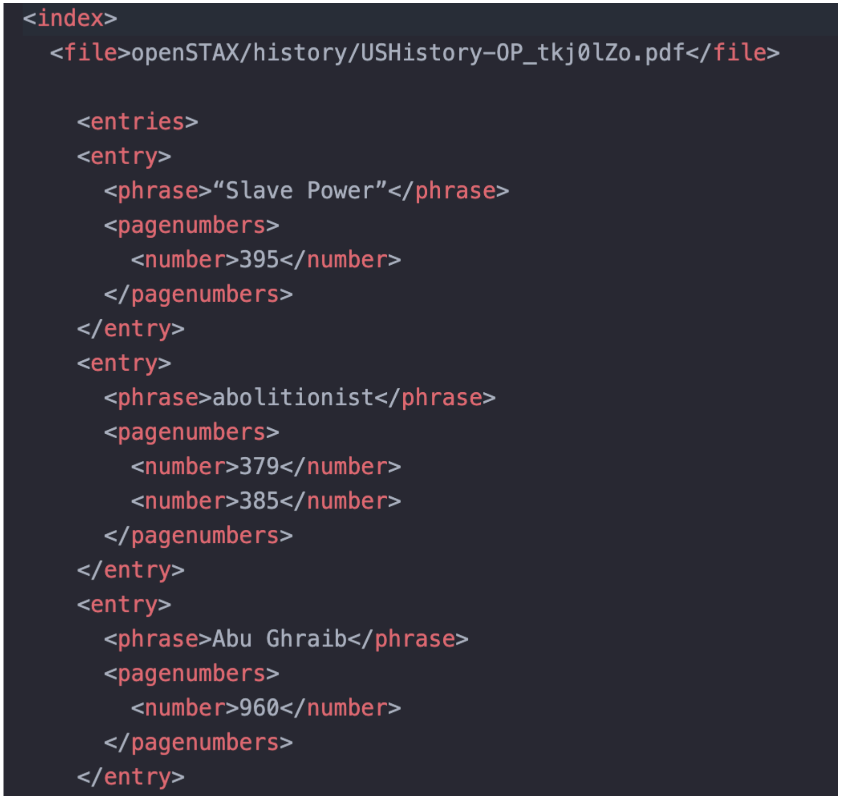

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    </entry>
    <entry>
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      <pagenumbers>
        <number>379</number>
        <number>385</number>
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    </entry>
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      <phrase>Abu Ghraib</phrase>
      <pagenumbers>
        <number>960</number>
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    </entry>
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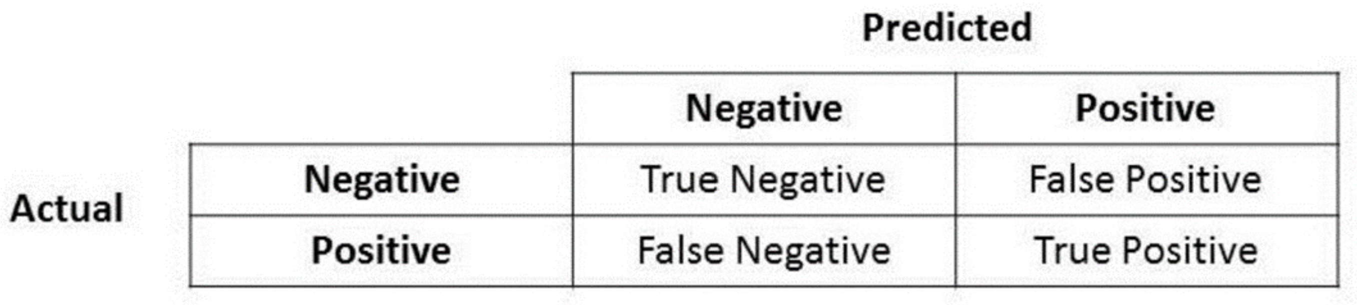
U. S. History [1]

Evaluation Method: Precision, Recall and F1 Metric

Precision = $$\frac{\text{Correctly Extracted Index Entries}}{\text{Correctly Extracted Index Entries} + \text{Falsely Extracted Index Entries}}$$

Recall = $$\frac{\text{Correctly Extracted Index Entries}}{\text{Correctly Extracted Index Entries} + \text{Falsely Considered as Other Text Part}}$$

F1 = $$2 * \frac{Precision * Recall}{Precision + Recall}$$



		Predicted	
		Negative	**Positive**
Actual	**Negative**	True Negative	False Positive
	Positive	False Negative	True Positive

Accuracy, Precision, Recall or F1?[2]

Status Quo

Golden Standard

- Five manually created sample XML files for verification and testing

Programming language and library

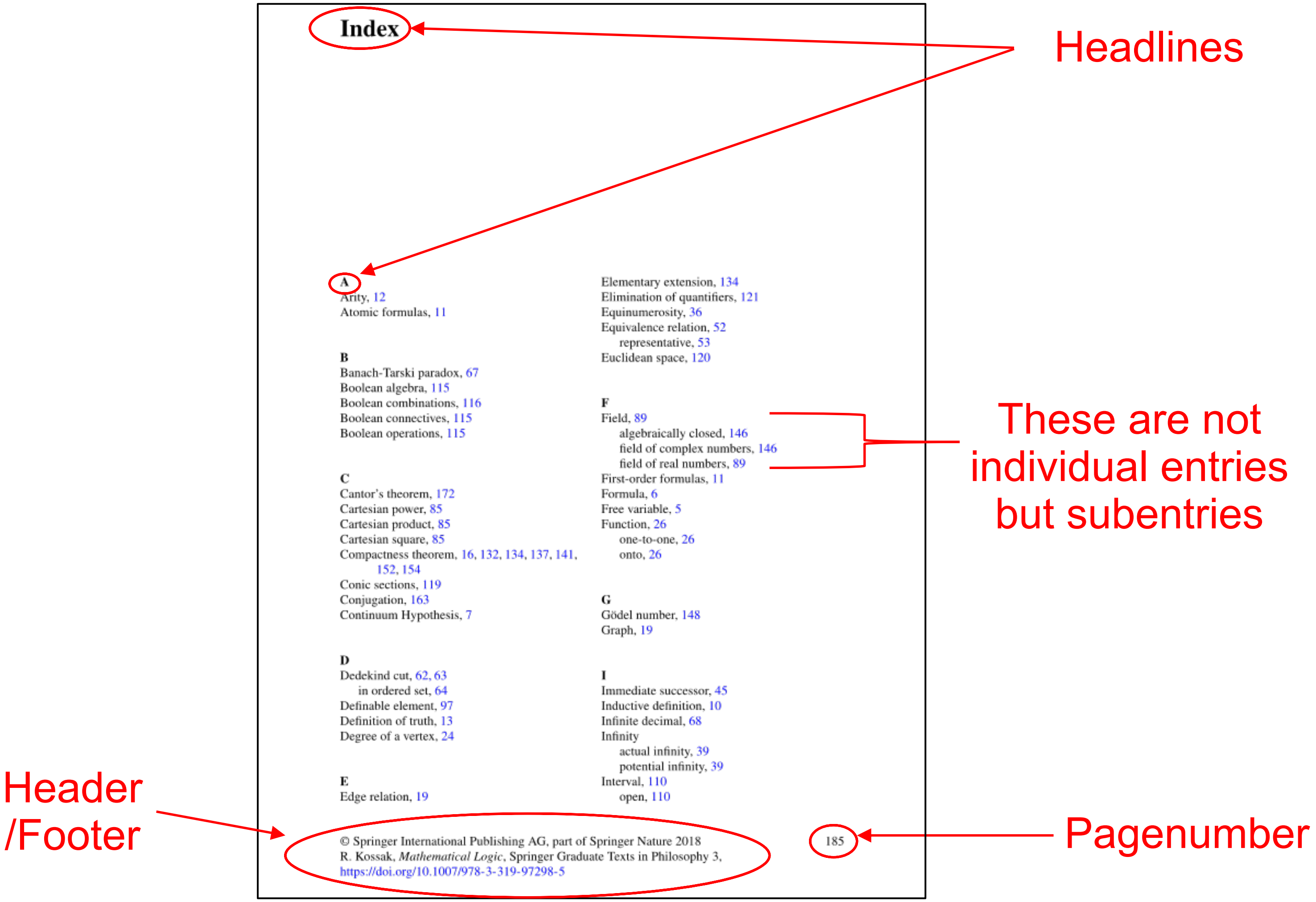
- Java
- PDFBox library

Raw text extraction

- Raw PDF to TXT extraction including all undesired content
- Basic filtering of undesired content and separating phrases from page numbers
- Performs well in one PDF but it still need to be optimized for general using

Main Obstacles Right Now

- Determining where the Index in any given PDF is
- Filtering and removal of non-relevant content (e.g. page number, header, etc)
- How to identify subphrases



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R. Kossak, *Mathematical Logic*, Springer Graduate Texts in Philosophy 3,
https://doi.org/10.1007/978-3-319-97298-5

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Headlines

These are not individual entries but subentries

Header /Footer

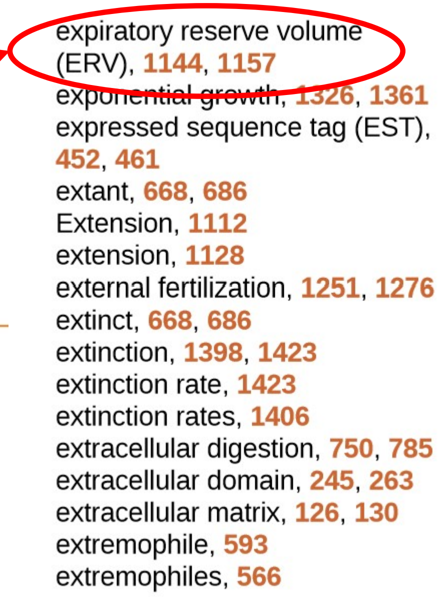
Pagenumber

Automata and Computability [3]

Further Problems: Special Cases

- Some special symbols
- The phrase is too long and split into two lines
- How to distinguish between the hyphen existing in the phrase itself and the hyphen due to line breaks

Line break due to long entrys



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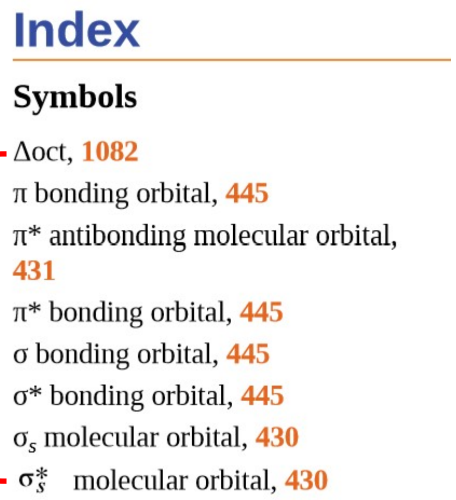
special symbols



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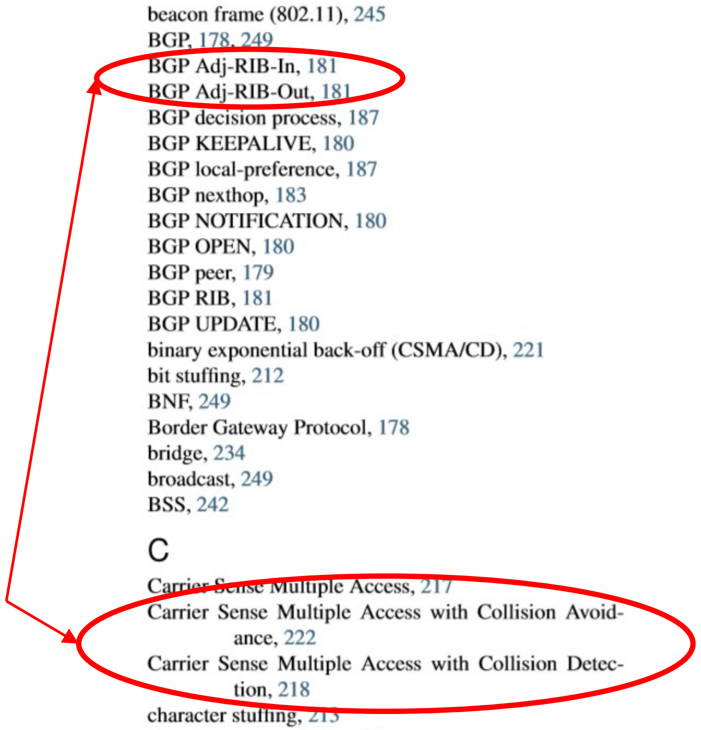

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Chemistry-OP [4]
Biology-OP[5]
Computer-Networking-Principles-Bonaventure-1-30-31-OTC1 [6]

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[1] Corbett, P. S., Volker, J., Lund, J. M., Pfannestiel, T., Vickery, P. S., & Janssen, V. (2014). *U. S. History*. Amsterdam, Niederlande: Amsterdam University Press.

[2] Koo Ping Shung, (Mar 15, 2018) Accuracy, Precision, Recall or F1? https://towardsdatascience.com/accuracy-precision-recall-or-f1-331fb37c5cb9

[3] Kozen, D. C. (2013). *Automata and Computability*. New York, Vereinigte Staaten: Springer Publishing.

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