Page Number Extraction On Scanned Books

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Introduction

Old books are scanned by **Optical Character Recognition** to create their electronic format for preservation and archiving purposes. While scanning, page number recognition is prone to a high variety of errors.

- Pages of a book may be skipped by human error or ripped out
- OCR software might interpret numbers incorrectly
- Page numbers also come in different numbering styles(e.g roman numerals etc.)

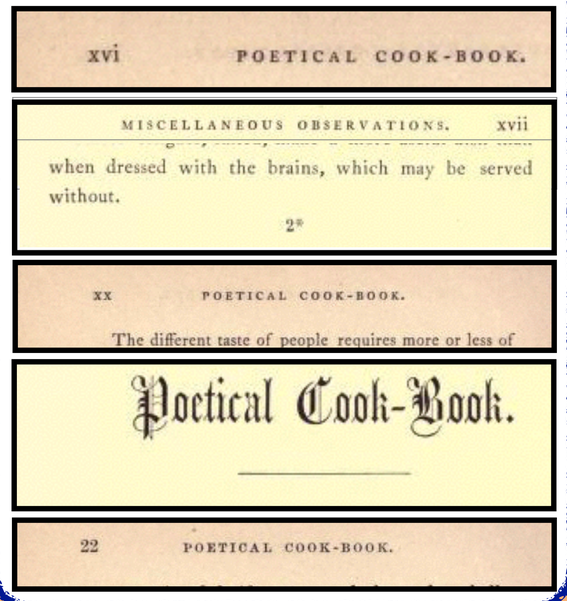
All these factors increase the complexity of this problem.

In 2008, Déjean & Meunier explored this problem on well and consistently formatted books only.

Déjean, Hervé, and Jean-Luc Meunier. "Versatile page numbering analysis." *Electronic Imaging 2008*. International Society for Optics and Photonics, 2008.

Visual examples of a problematic sequence of five consecutive pages from a book:

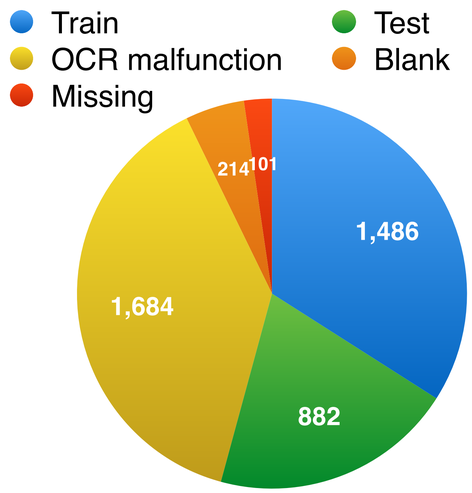
16(xvi), 17(xvii) or 2*, [18? 19?], 20(xx), blank, 22



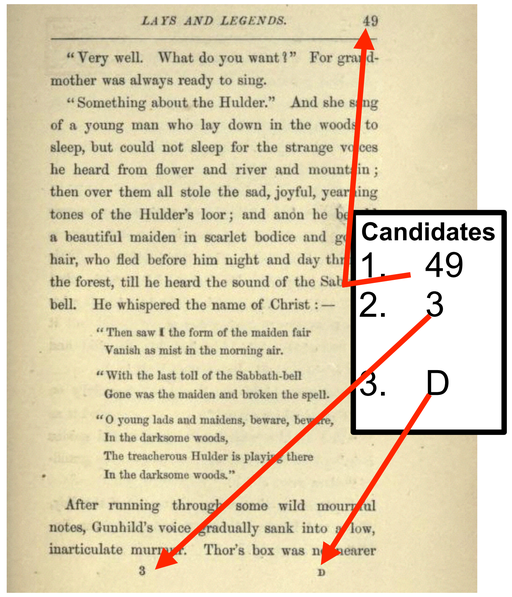
Algorithmic Approach

- Uses ML approach with svmrank
- Create parser to extract page number candidates
- Extract features for each candidate
- Generate train & test splits on 25,000 candidates
- Pass feature & candidate data to learning algorithm
- Feed test data to rank classifier to get best ranked candidate for *each page*
- Obtain accuracy of best ranked candidates

Page distribution in dataset



Evaluation Approach



For each book, Overall Accuracy @ N = proportion of pages with correct answer at rank 1 to N

- To understand misclassification, look at missed correct candidates appearing in ranks 2 to 5
- During development, modify features /create special cases so correct candidates can be moved up to rank 1.

Features used in various models

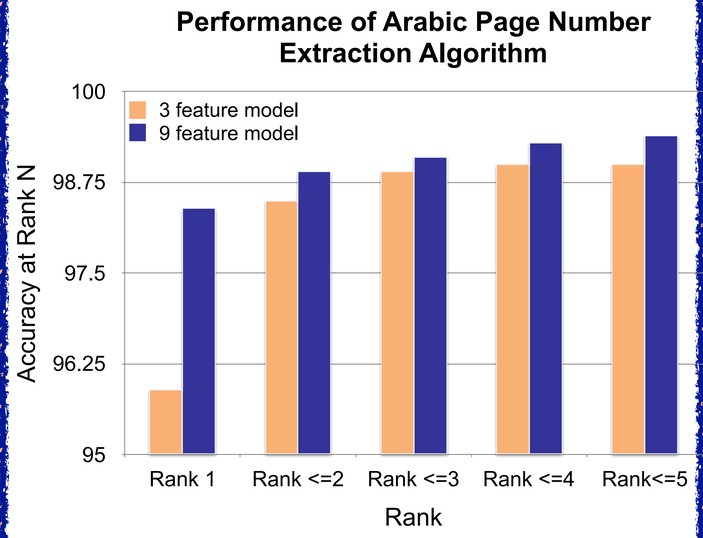
Initial model

- sequence
- % through the line
- % down through the page

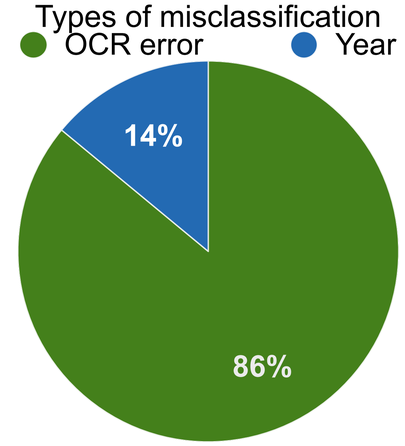
Final model

- is it a number?
- does it look like a number(i0, l, 1o, b,s)?
- % left through the line
- % up through the page
- x coordinate fraction
- y coordinate fraction

Results & Conclusion



- Overall page number extraction accuracy for 3 feature model is 95.9%.
- Overall page number extraction accuracy for 9 feature model is 98.4%.



- Improvement between models is around 3.5 %.
- 6 features added collectively to the model don't have as much as impact as 3 initial features.
- Didn't find a feature that greatly influences algorithm performance. Parser impacts greatly but its performance isn't quantified.