Karlsruhe Institute of Technology

Text Indexing

Lecture 00: Course Overview

Florian Kurpicz

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Organizational Matters

Lectures

- Monday 14:00–15:30 (50.34, 236)
- lecture only

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- coding project and small presentation
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Office Hours (Room 210)

- Monday 15:30–16:00 (lecture period)
- by appointment (otherwise)

Materials

Slides

- published shortly before the lecture (`https://algo2.iti.kit.edu/4612.php`)

Videos

- online for old lectures, new topics will be recorded

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Additional Material

- references to literature included
- books
  - Gonzalo Navarro. *Compact Data Structures - A Practical Approach*. Cambridge University Press, 2016. ISBN: 978-1-10-715238-0
  - Enno Ohlebusch. *Bioinformatics Algorithms: Sequence Analysis, Genome Rearrangements, and Phylogenetic Reconstruction*. Oldenbusch Verlag, 2013. ISBN: 978-3000413162
- most likely no script

Content

Fundamentals

- tries
- suffix tree
- suffix array
- longest common prefix array
- Burrows-Wheeler transform (BWT)
- wavelet tree (+ bit vector rank/select)
- FM-index

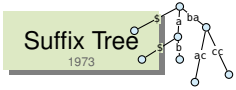
Compressed Indices

- compressing the BWT and wavelet trees
- Lempel-Ziv 77/78 compression
- LZ compression vs. BWT compression
- compressed suffix trees and suffix arrays
- r-index

Additional Topics

- parallel construction
- different query types

From the Suffix Tree to the *r*-Index



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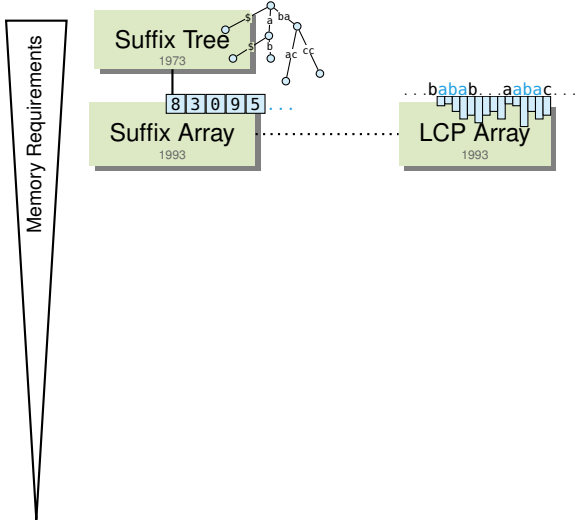

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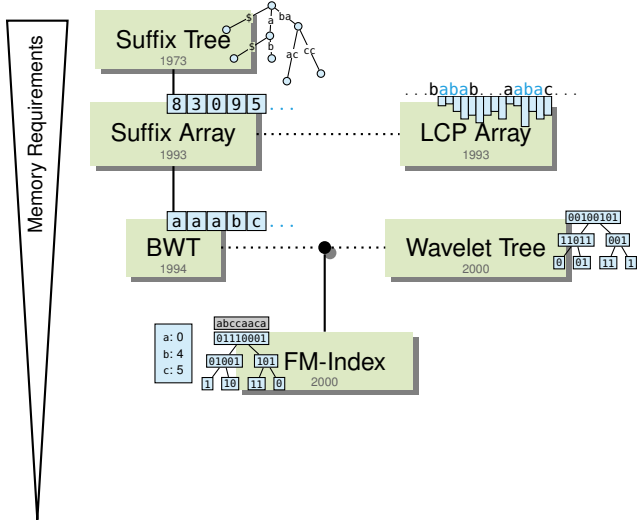

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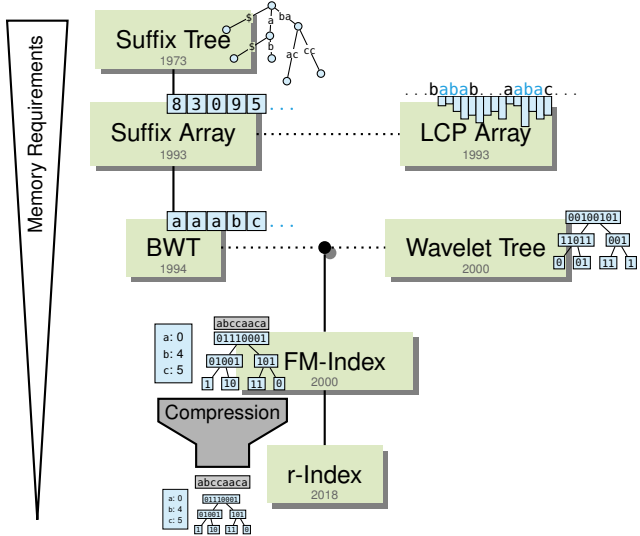
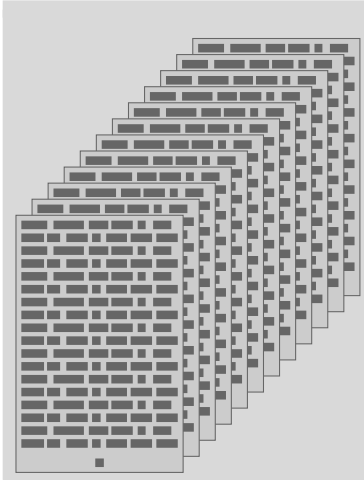


Motivation for Text Indices



- collection of text
- scanning not feasible

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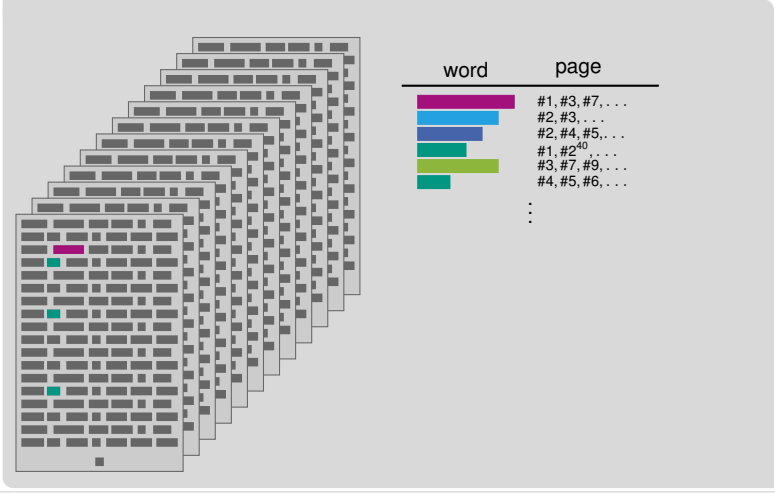

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- inverted index (word based)

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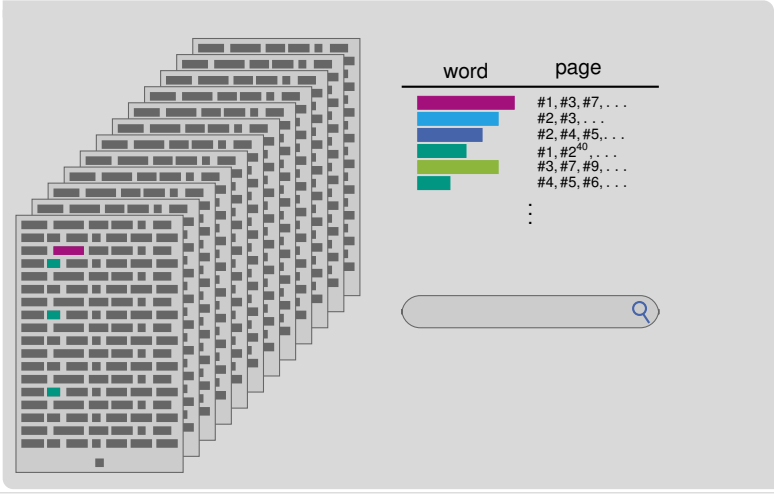

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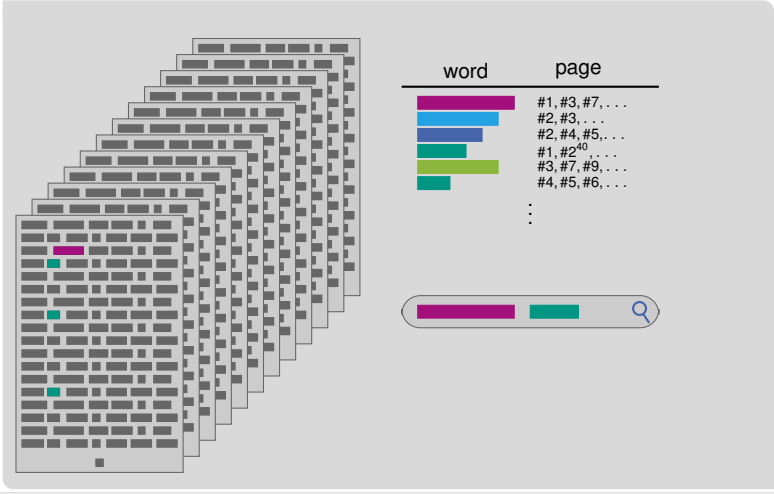

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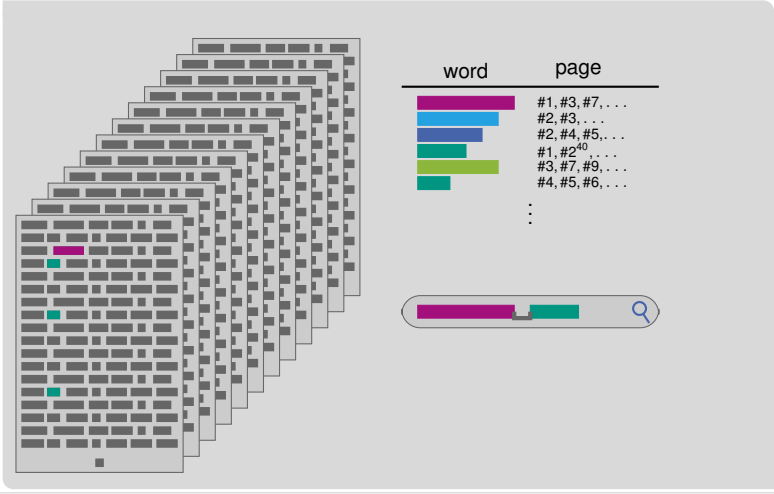

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- scanning not feasible
- inverted index (word based)
- phrase search

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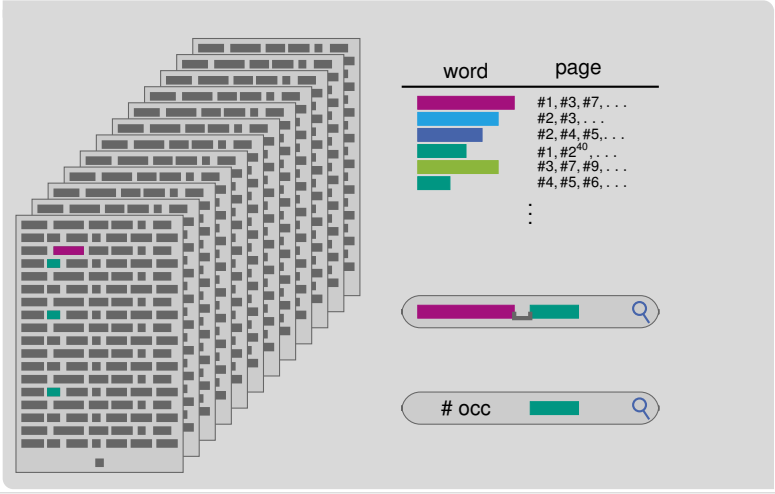

- collection of text
- scanning not feasible
- inverted index (word based)
- phrase search
- counting queries

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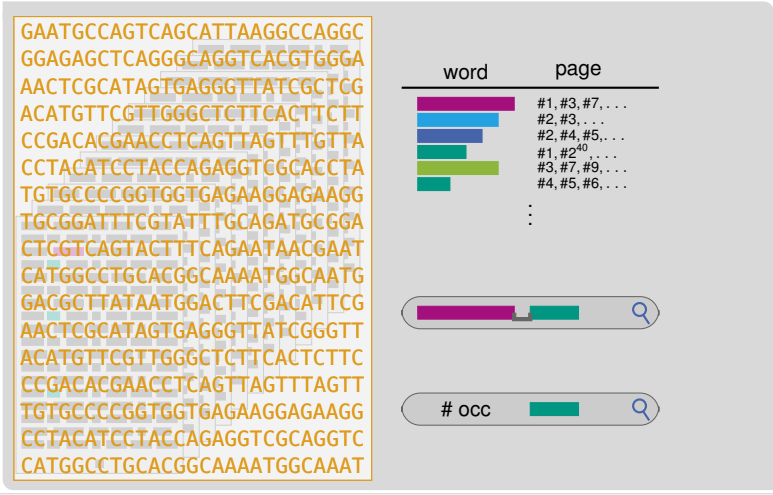
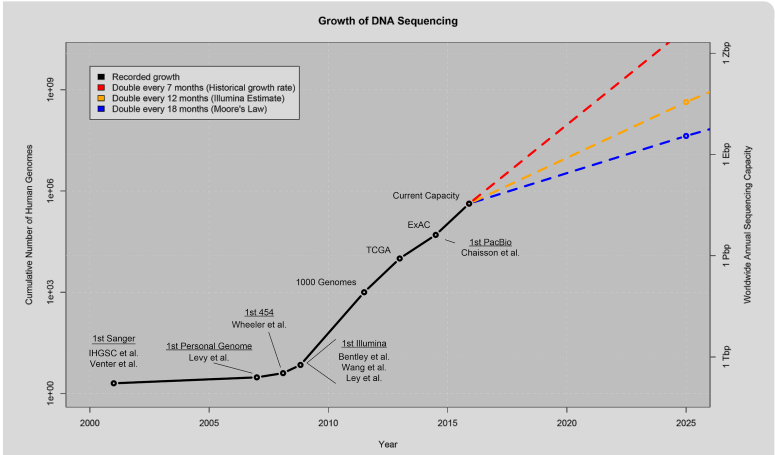


- collection of text
- scanning not feasible
- inverted index (word based)
- phrase search
- counting queries
- what if there are no “words”

Why Texts?

Text is Everywhere

- Text-based Information
  - Wikipedia $\mathbb{W}$
  - dblp
  - books
  - news articles
  - code
- Very Important in Bioinformatics
  - DNA
  - proteins



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Bibliography

[Nav16] Gonzalo Navarro. *Compact Data Structures - A Practical Approach*. Cambridge University Press, 2016. ISBN: 978-1-10-715238-0.

[Ohl13] Enno Ohlebusch. *Bioinformatics Algorithms: Sequence Analysis, Genome Rearrangements, and Phylogenetic Reconstruction*. Oldenbusch Verlag, 2013. ISBN: 978-3000413162.

[Ste+15] Zachary D Stephens., Skylar Y. Lee, Faraz Faghri, Roy H. Campbell, Chengxiang Zhai, Miles J. Efron, Ravishankar Iyer, Michael C. Schatz, Saurabh Sinha, and Gene E. Robinson. “Big Data: Astronomical or Genomical?” In: *PLOS Biology* 13.7 (July 2015), pages 1–11. DOI: 10.1371/journal.pbio.1002195.