

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
- 20 % of the final grade

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- 80 % of the final grade
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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/4326.php>)

Videos

- will be published (with ≥ 1 week delay)

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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

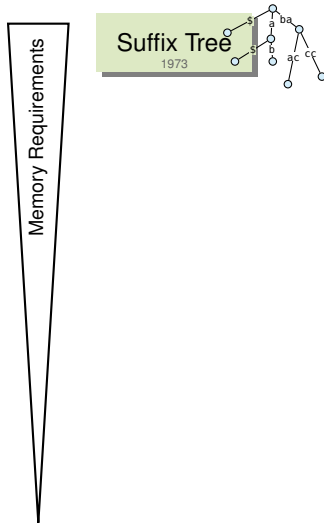
Compressed Indices

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

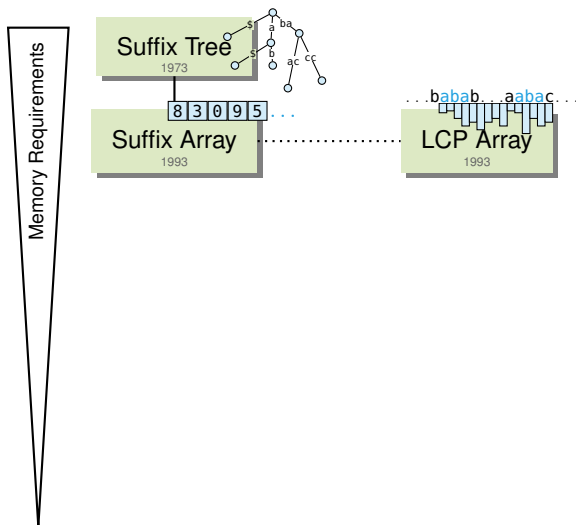
Additional Topics

- parallel construction
- different query types

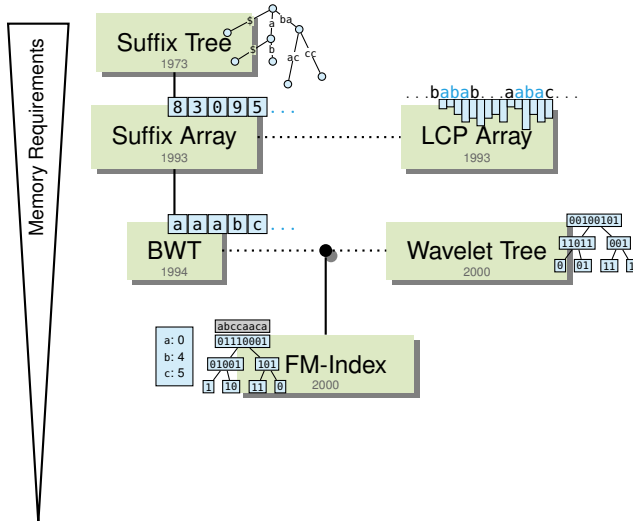
From the Suffix Tree to the r -Index



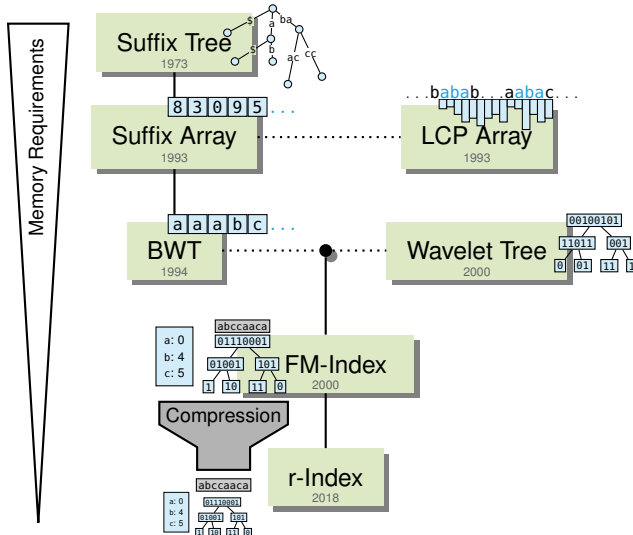
From the Suffix Tree to the r -Index



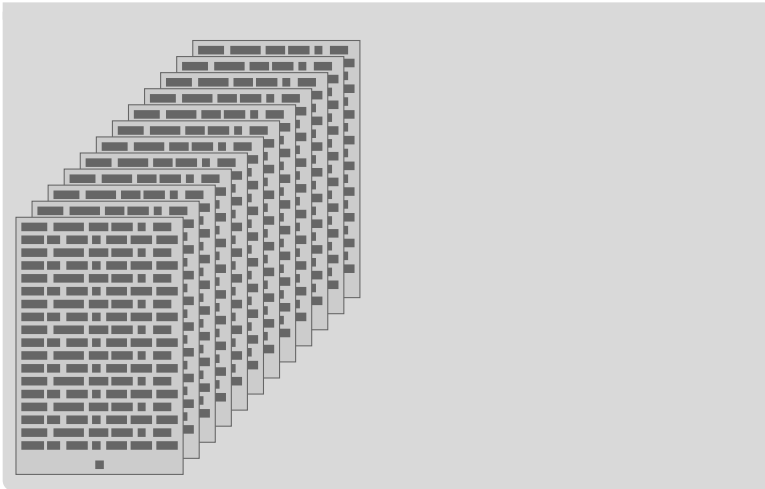
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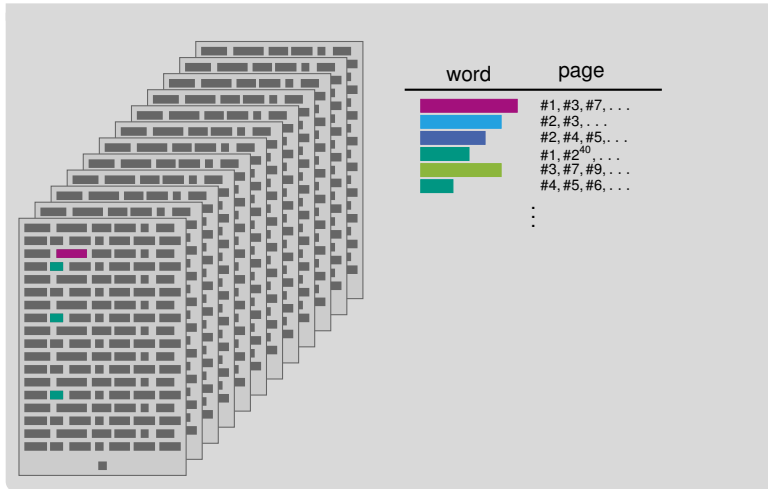


Motivation for Text Indices



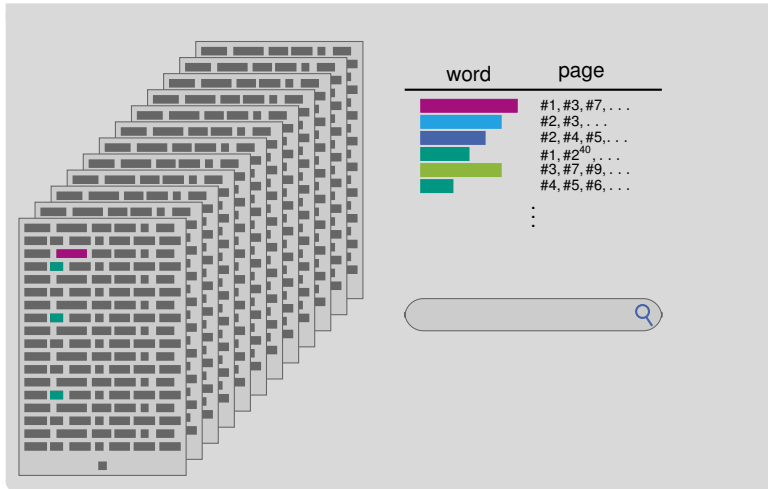
- collection of text
- scanning not feasible

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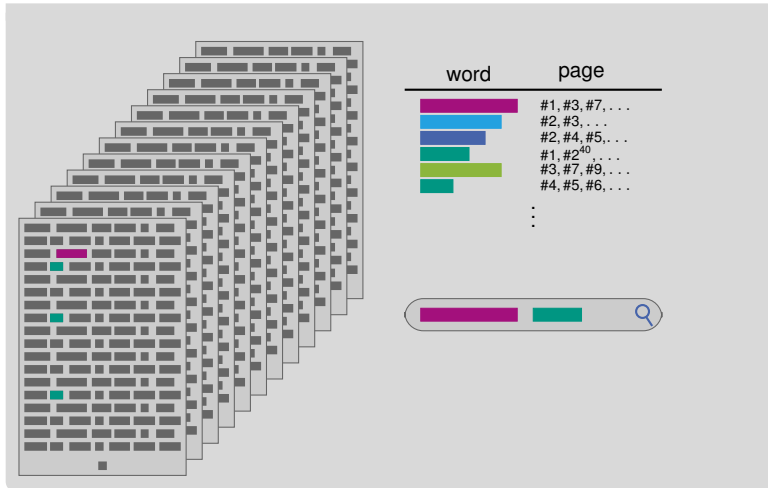
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- scanning not feasible
- inverted index (word based)

Motivation for Text Indices



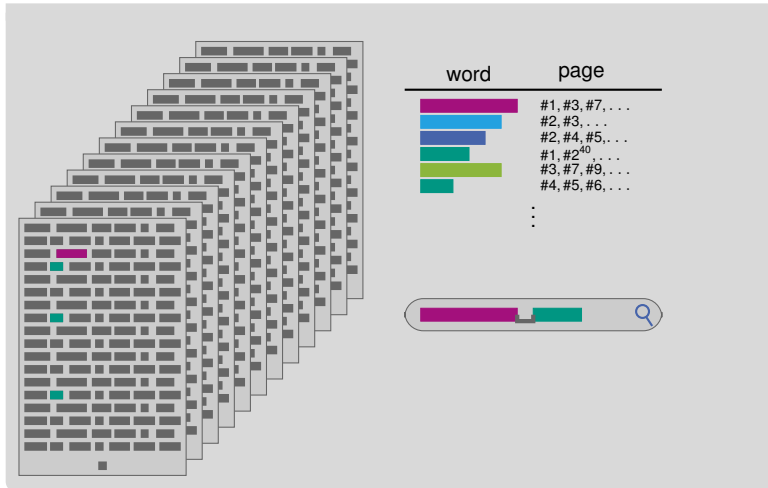
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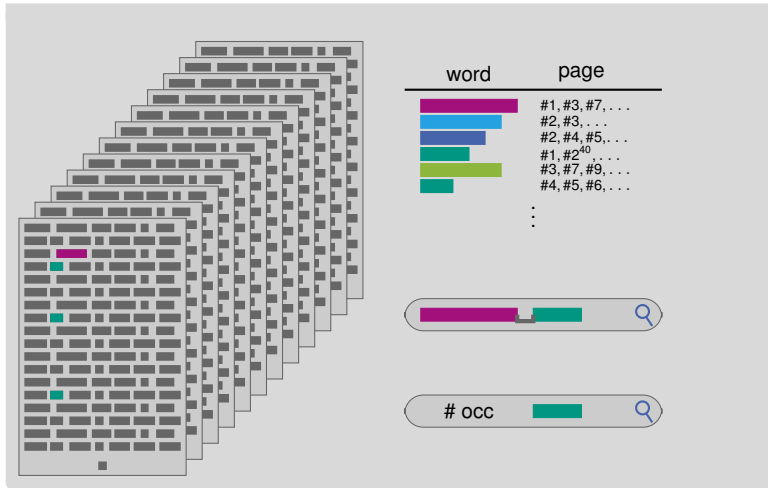
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Motivation for Text Indices



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







Motivation for Text Indices



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

Motivation for Text Indices

GAATGCCAGTCAGCATTAAAGGCCAGGC
 GGAGAGCTCAGGGCAGGTCACGTGGGA
 AACTCGCATAGTGAGGGTTATCGCTCG
 ACATGTTTCGTTGGGCTCTTCACTTCTT
 CCGACACGAACCTCAGTTAGTTTGTTA
 CCTACATCCTACCAGAGGTCGCACCTA
 TGTGCCCCGGTGGTGAGAAGGAGAAGG
 TGC GGATTTCGTATTTGCAGATGCGGA
 CTGTCAGTACTTTCAGAATAACGAAT
 CATGGCCTGCACGGCAAATGGCAATG
 GACGCTTATAATGGACTTCGACATTTCG
 AACTCGCATAGTGAGGGTTATCGGGTT
 ACATGTTTCGTTGGGCTCTTCACTTCTT
 CCGACACGAACCTCAGTTAGTTTAGTT
 TGTGCCCCGGTGGTGAGAAGGAGAAGG
 CCTACATCCTACCAGAGGTCGCAGGTC
 CATGGCCTGCACGGCAAATGGCAAAT

word	page
	#1, #3, #7, ...
	#2, #3, ...
	#2, #4, #5, ...
	#1, #2 ⁴⁰ , ...
	#3, #7, #9, ...
	#4, #5, #6, ...
	⋮



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

Why Texts?

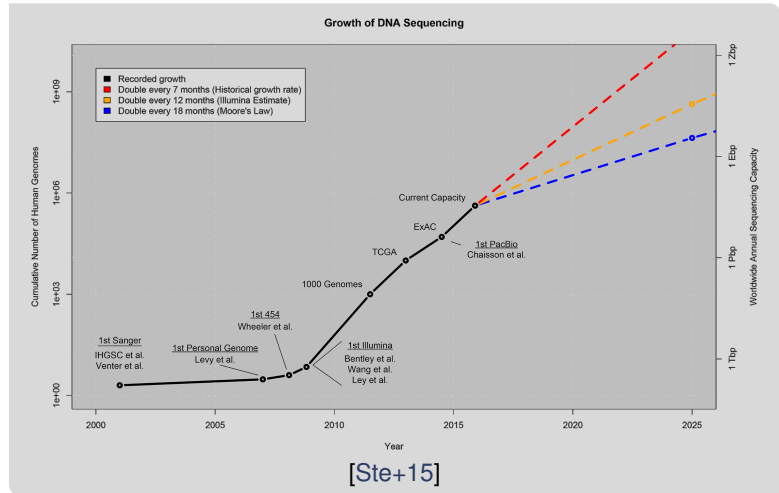
Text is Everywhere

Text-based Information

- Wikipedia 
- dblp 
- books 
- news articles 
- code 

Very Important in Bioinformatics

- DNA 
- proteins 



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](https://doi.org/10.1371/journal.pbio.1002195).