Set Similarity Joins - Introduction

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October 29, 2018

Thanks to Willi Mann for providing many of the slides.

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   - very slow (1TB from hard disk $\rightarrow$ lasts multiple hours)

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3. Hashing: digit sum / pigeon holes
   - digit sum determines pigeon hole



Standard Approaches do not work

- Sort: Errors destroy ordering

Customers

Name ↓	Location
Frieda	Bozen
Frodo	Auenland
Maria	Meran

Customers

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- Hashing: Errors change digit sum

0	1	2	3	4
	Frodo Frieda		Maria	

0	1	2	3	4
	Frieda	Vrodo	Maria	

Similarity of Sets

- Many similarity criteria can be expressed as set overlaps
- Examples:
  - Words in text documents or websites
  - Friends on Facebook
  - Products in a shopping basket
  - Tags on Flickr
  - Click stream: Links clicked by a user
  - ...

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$$R \overset{\text{sim}}{\bowtie} S = \{(r, s) \in R \times S | \operatorname{sim}(r, s) \geq t\}$$

Similarity Join: Find all Similar Pairs

- Data set: Titles and authors of $n = 873.524$ publications (DBLP)
  - Sets with an average word count of 15 (min. 2, max: 289)
  - Zipf-distributed word frequencies, 408.824 different words
  - Goal: find pairs of sets sharing many elements (e.g., 90%)

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- Naive solution: Compute all overlaps
  1. Compute overlap for all pairs of sets
  2. Return pairs for which the overlap is large enough
     $\rightarrow$ very inefficient: $O(n^2)$ computed overlaps (˜381 billion)

Clever Solution

- Compare lengths and start computation for sets of similar size
- Terminate as soon as it is guaranteed the overlap is not reachable anymore
  $\rightarrow$ single comparisons are very efficient (6-20ns)

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- Compare lengths and start computation for sets of similar size
- Terminate as soon as it is guaranteed the overlap is not reachable anymore
  $\rightarrow$ single comparisons are very efficient (6-20ns)
- However, still too many comparisons ...
  $\rightarrow$ still $O(n^2)$ comparisons (˜381 billion)

Overlap	Runtime
0.95%	2201 s
0.90%	3136 s
0.80 %	4280 s
0.70 %	7770 s

Complexity

R	S
$\{a, b\}_{r_1}$	$\{a, b\}_{s_1}$
$\{d, g\}_{r_2}$	$\{c, e\}_{s_2}$
$\{c, f\}_{r_3}$	$\{c, g\}_{s_3}$

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$|r_1 \cap s_1| = 2 \quad |r_1 \cap s_2| = 0 \quad |r_1 \cap s_3| = 0$

Complexity

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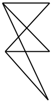
$\{a, b\}_{r_1}$		$\{a, b\}_{s_1}$
$\{d, g\}_{r_2}$		$\{c, e\}_{s_2}$
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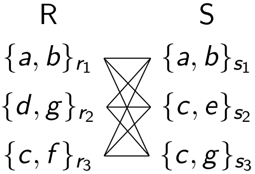
Complexity



$$
\begin{array}{lll}
|r_1 \cap s_1| = 2 & |r_1 \cap s_2| = 0 & |r_1 \cap s_3| = 0 \\
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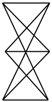
Complexity / Inverted List Index

R		S
$\{a, b\}_{r_1}$		$\{a, b\}_{s_1}$
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S

a: s_1

b: s_1

c: s_2, s_3

e: s_2

g: s_3

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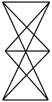
$\{a, b\}_{r_1}$		$\{a, b\}_{s_1}$
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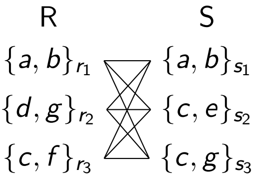

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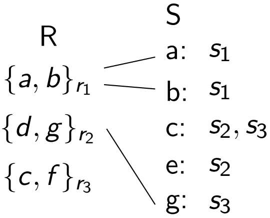

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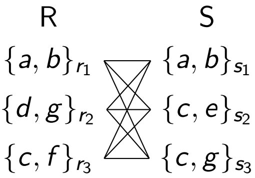

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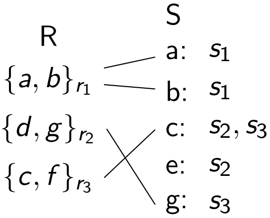

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Background - Prefix Filter[1]

$|r \cap s| \geq 4$

- Example
  - 2 sets
  - Sorted alphabetically
  - Scan from left to right to compute overlap:

r:	?	?	?	?	?
s:	?	?	?	?	?

max. overlap: 5

[1] S. Chaudhuri, V. Ganti, and R. Kaushik. A primitive operator for similarity joins in data cleaning. In Proc. ICDE, pages 5–16, 2006.

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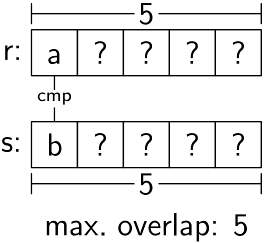

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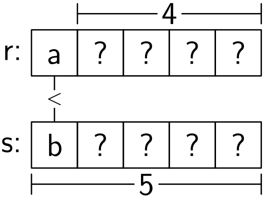

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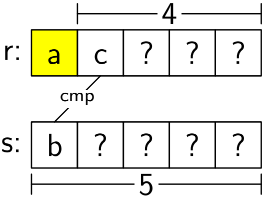

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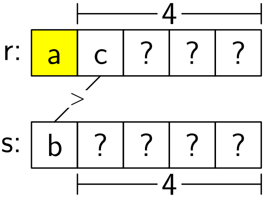

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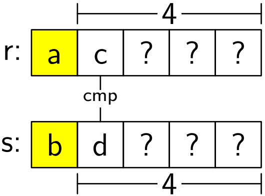

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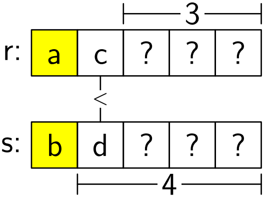

max. overlap: 3

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r:	a	c	e	f	g
s:	b	d	e	f	g

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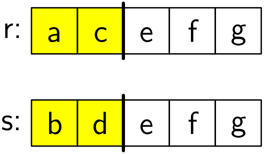

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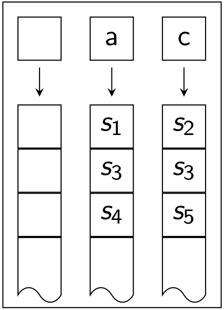
Background - Abstract Model of Algorithms

collection S
prefix index



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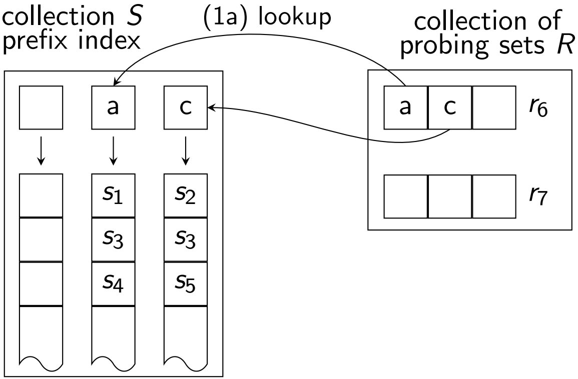

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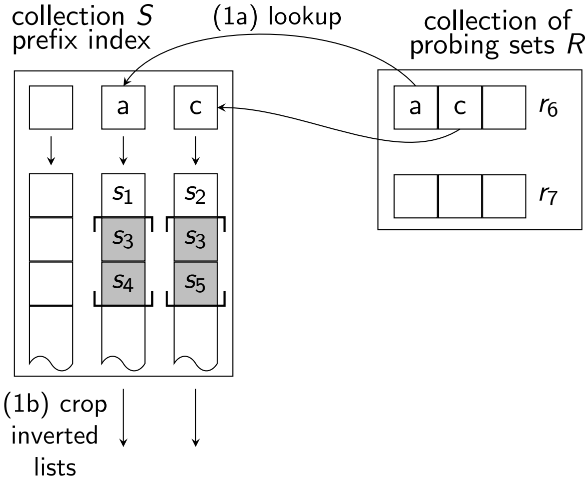

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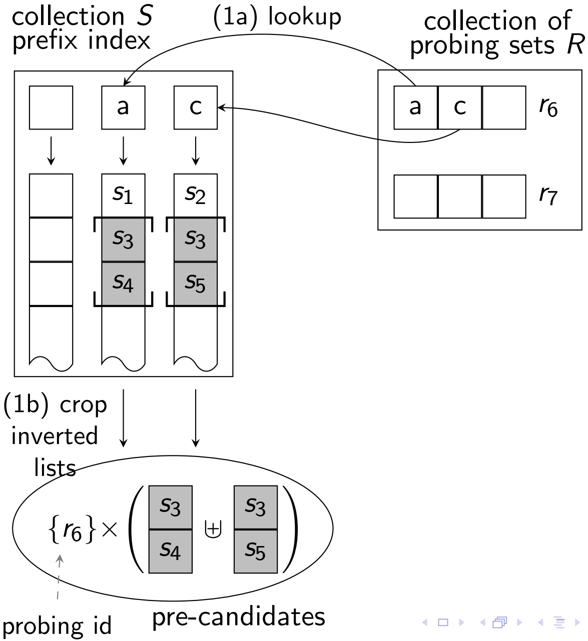

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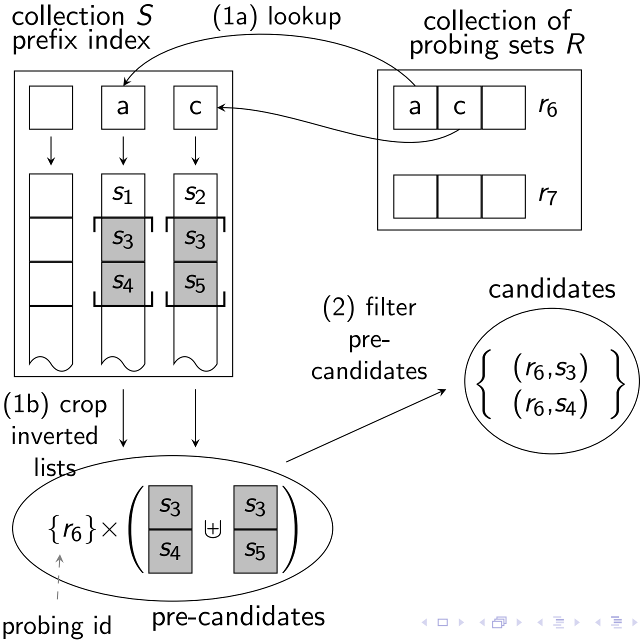

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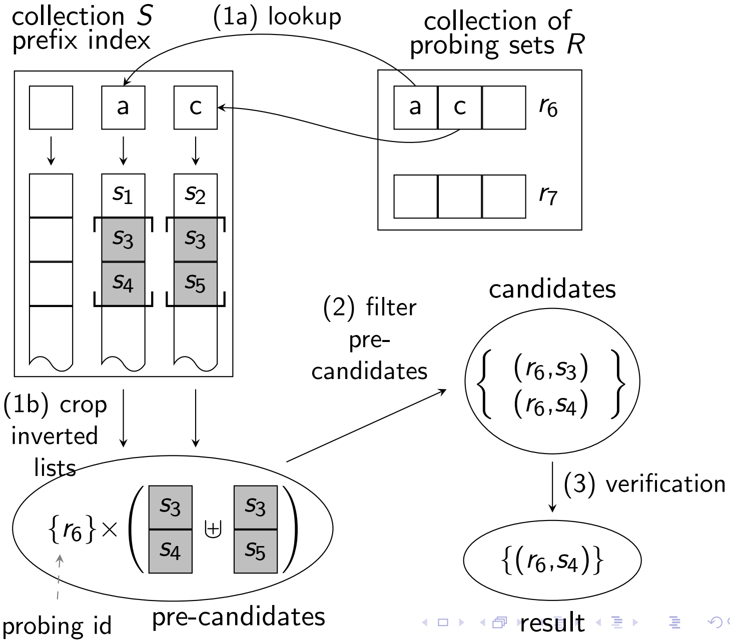

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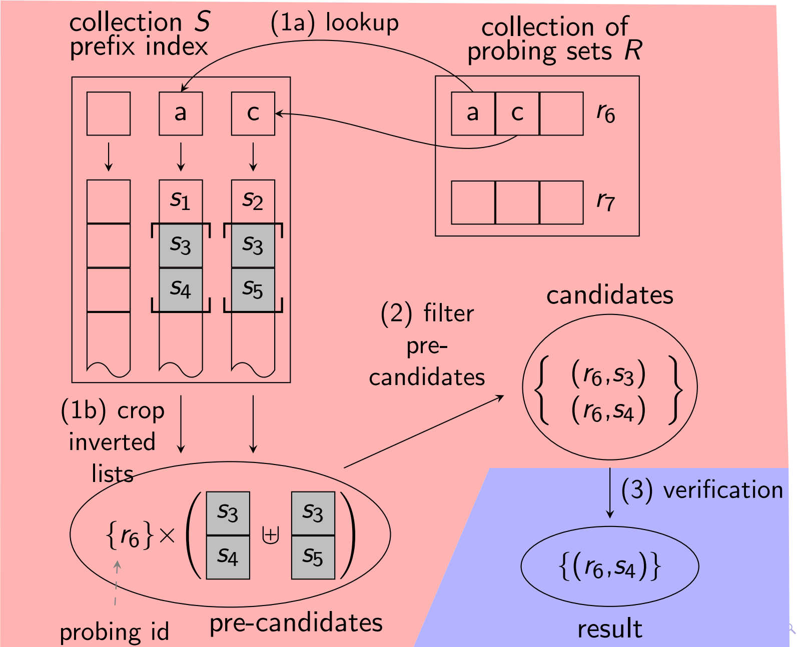

Preprocessing

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Here you find the preprocessing instructions for the datasets in this project:
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