Designing an Index for ZooDB

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May 30, 2014

Outline

ZooDB

- an open source object database written in Java
- JDO standard compliant
- 4 times faster than competitor db4o
- `zoodb.org`

Database Index

Key-Value data structure for fast retrieval and ordered iteration of entries stored in a file.

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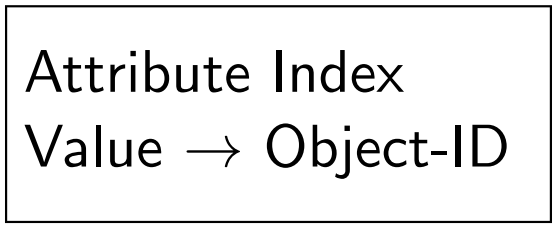

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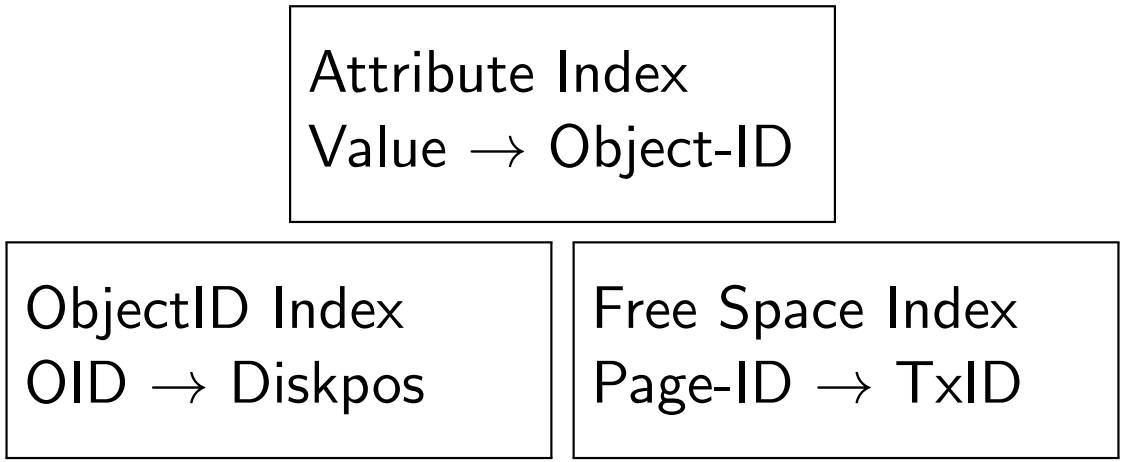

B+ Tree

Images adapted from Database Management Systems by Ramakrishnan and Gehrke.

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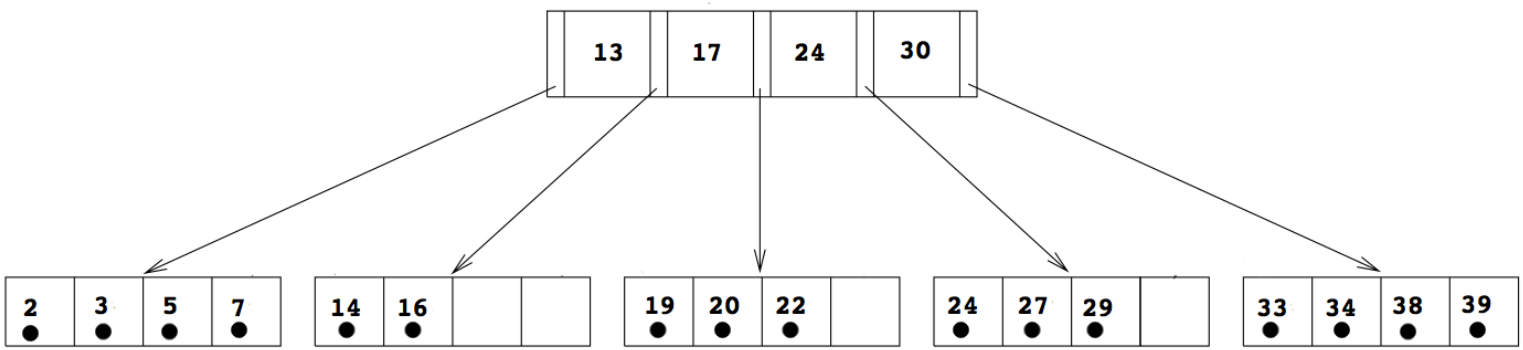

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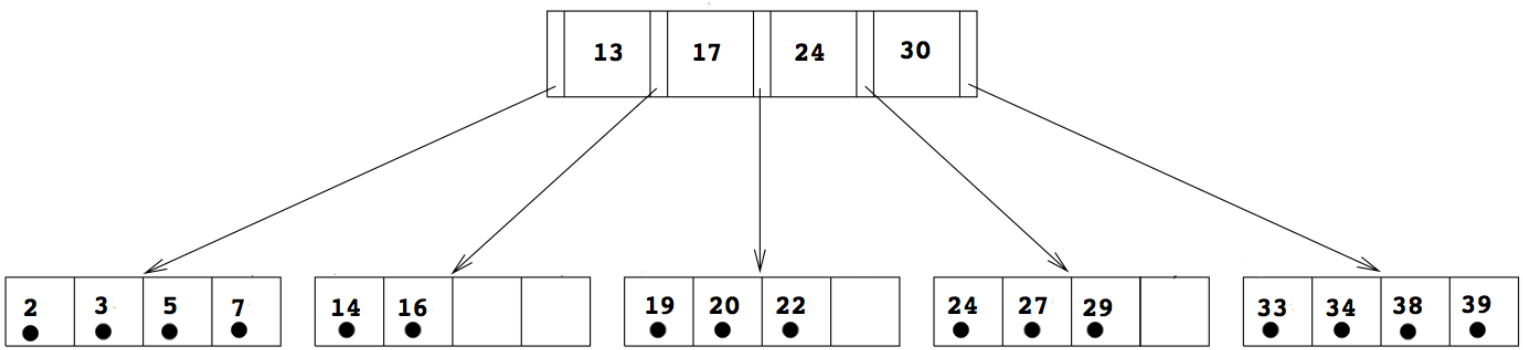

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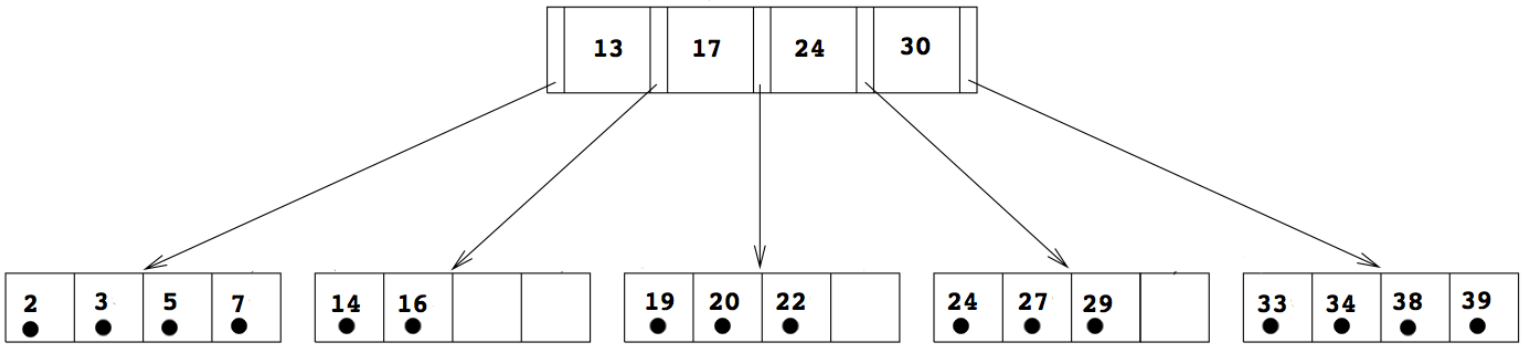

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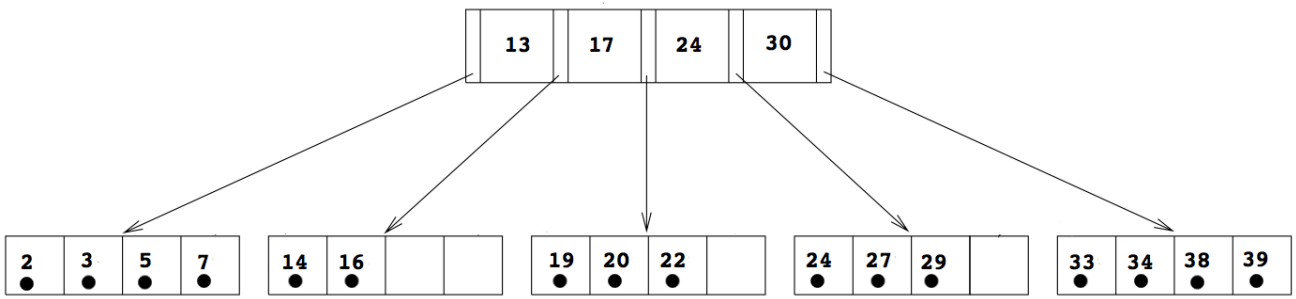

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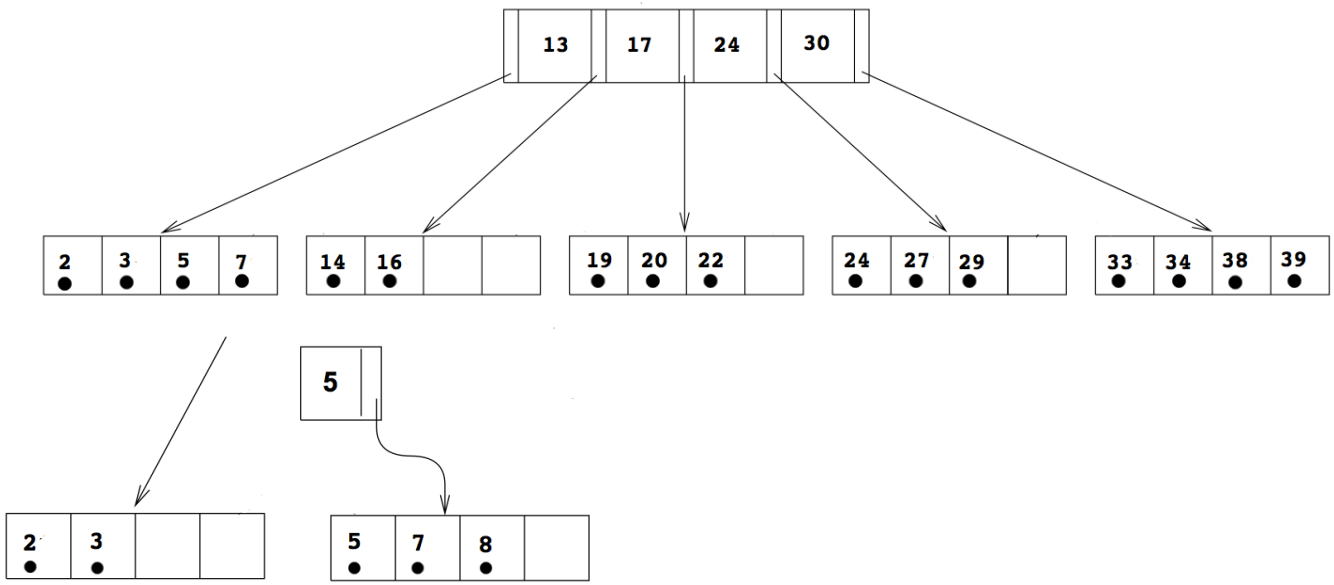

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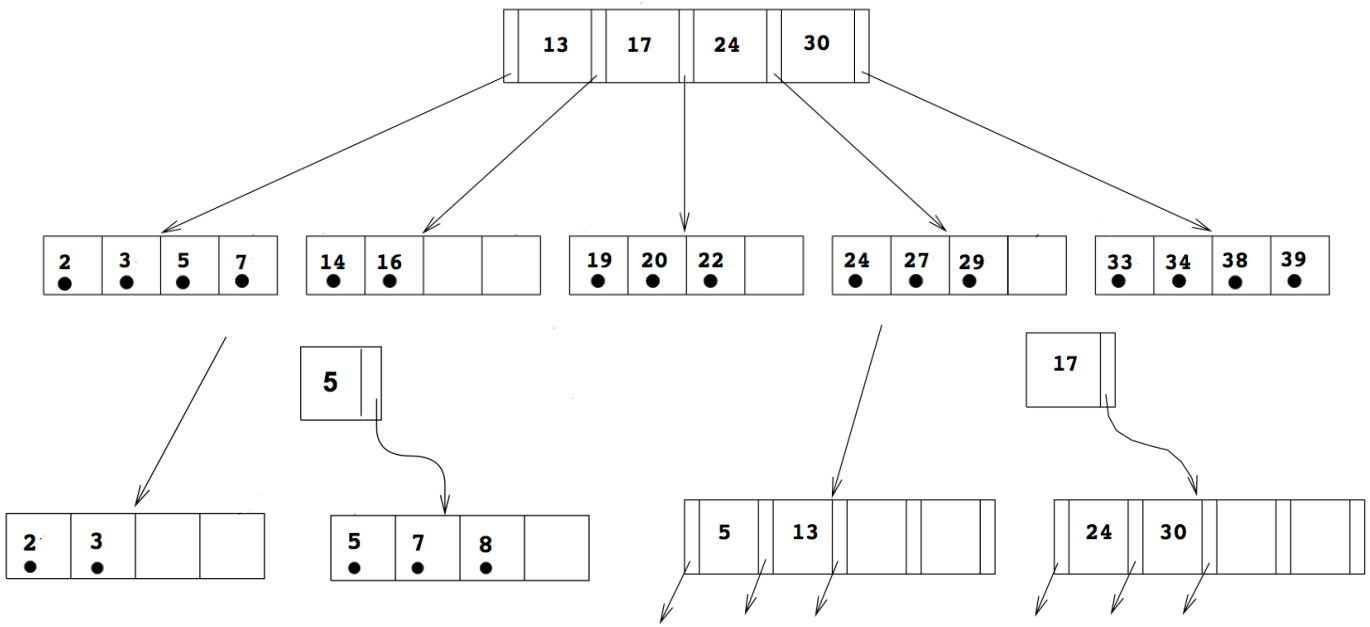

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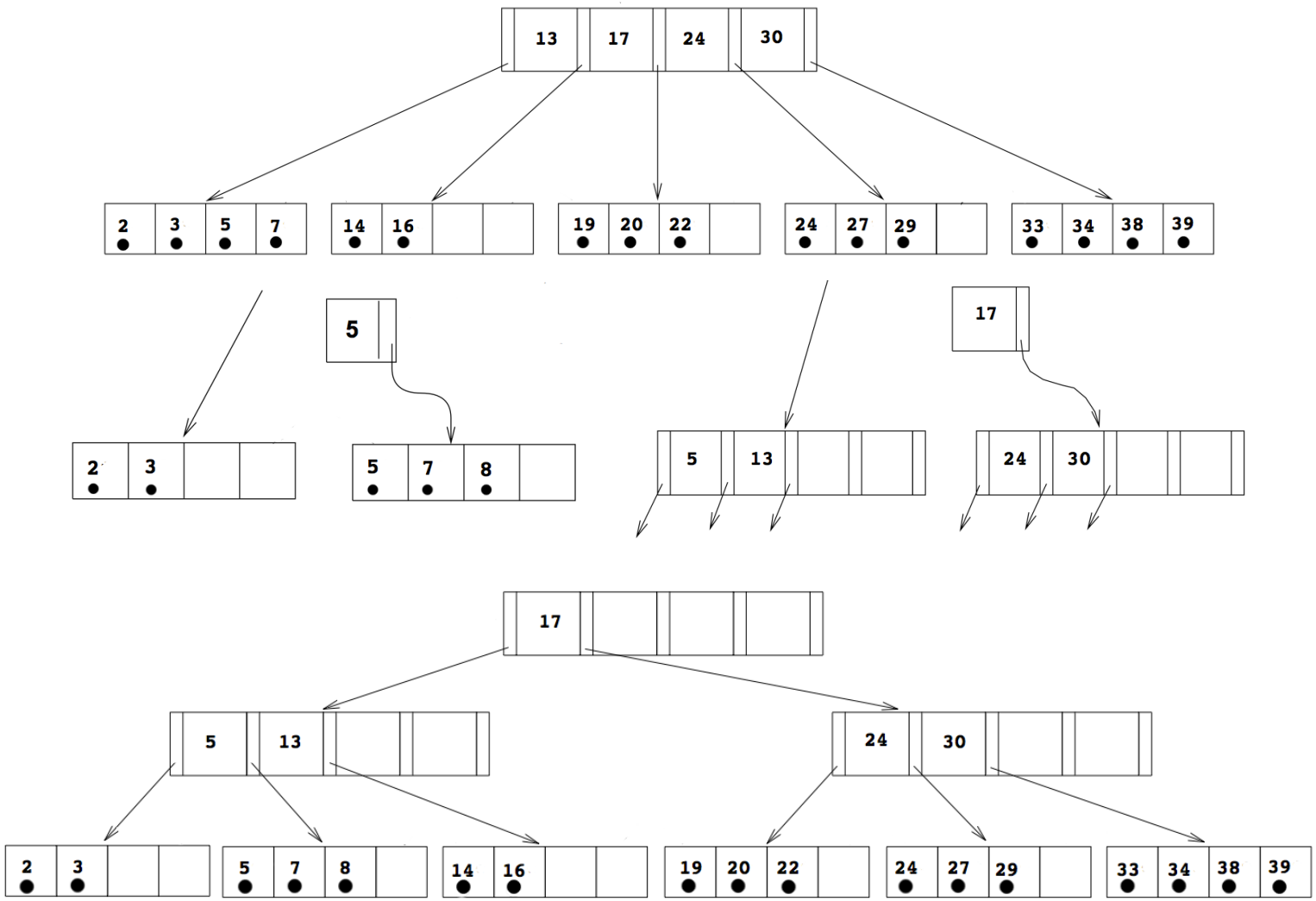

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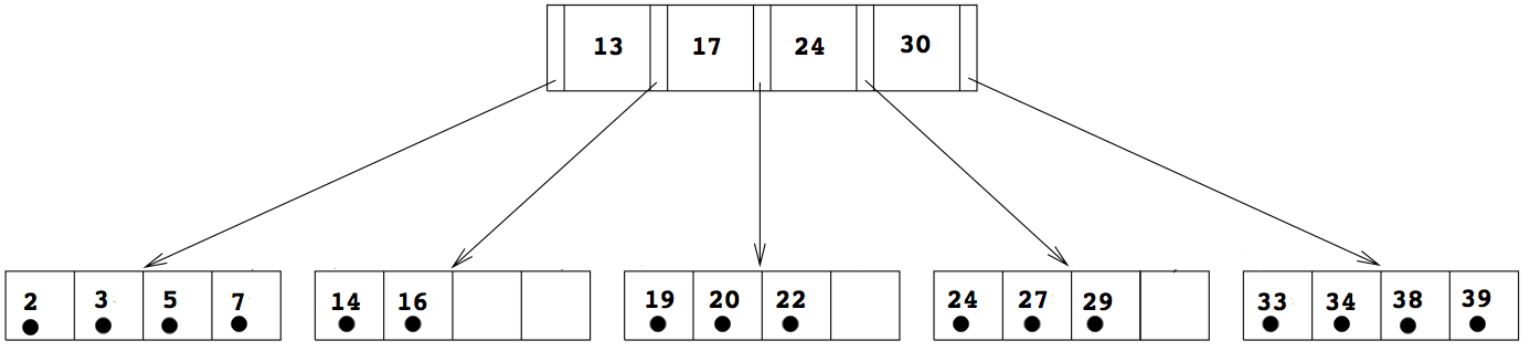

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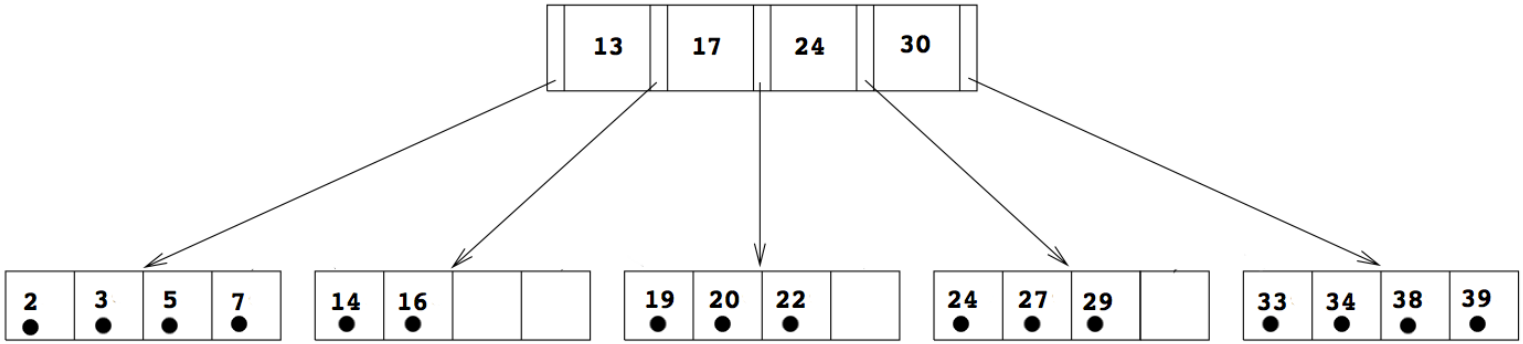

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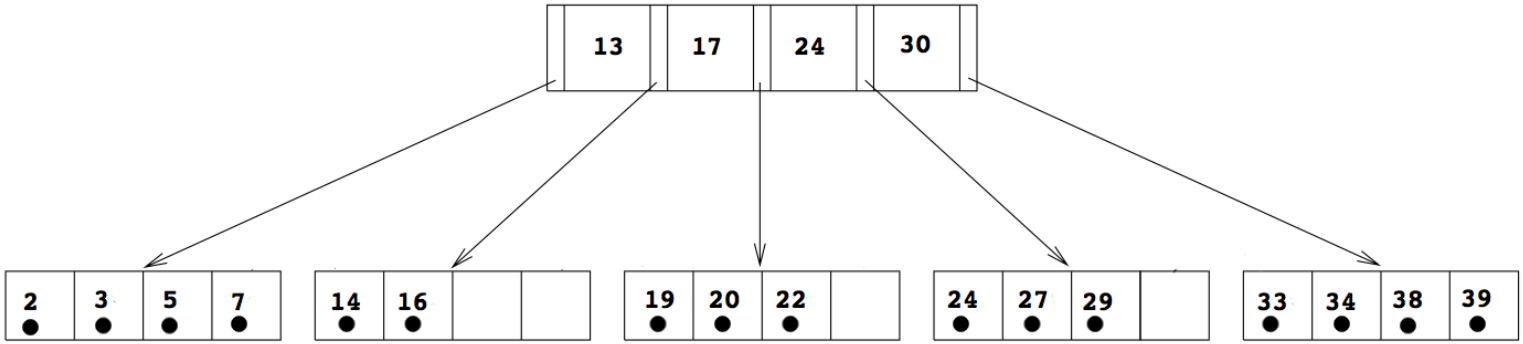

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- Insert, remove, search are logarithmic.

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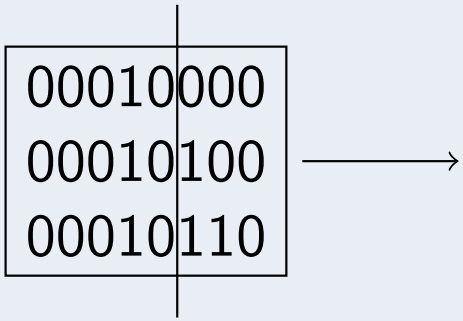

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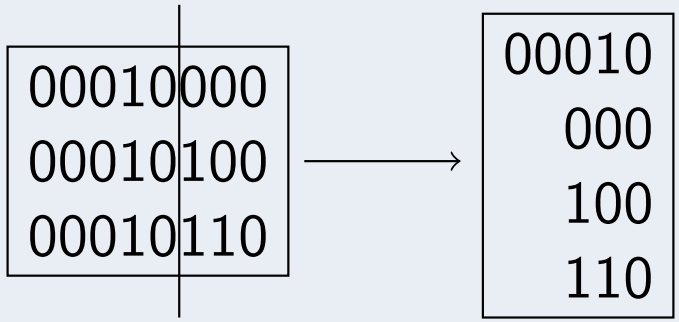

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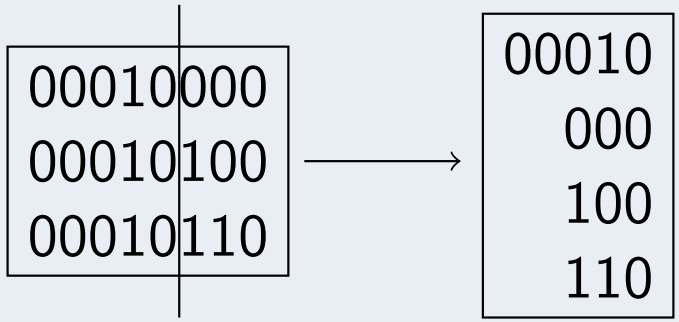

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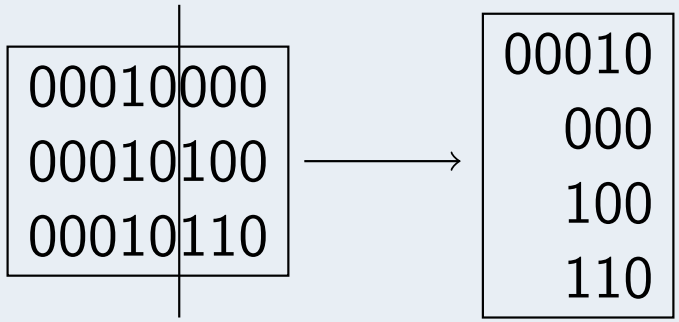

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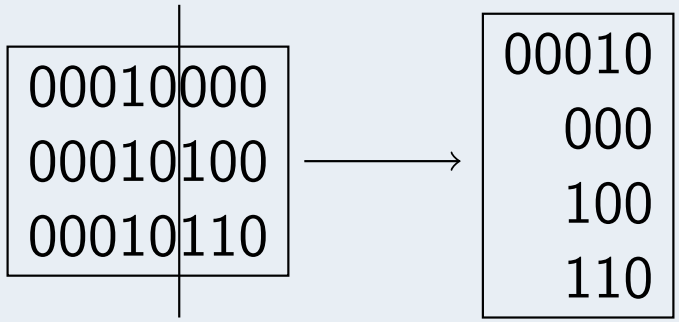

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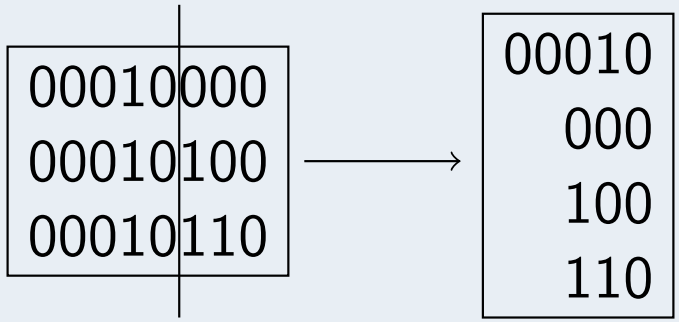

- variable number of key-value entries per node
- prefix determines
  - if two nodes can be split without underflow
  - if two nodes can be merged without overflow
  - the number of entries that can be redistributed from one node to the other

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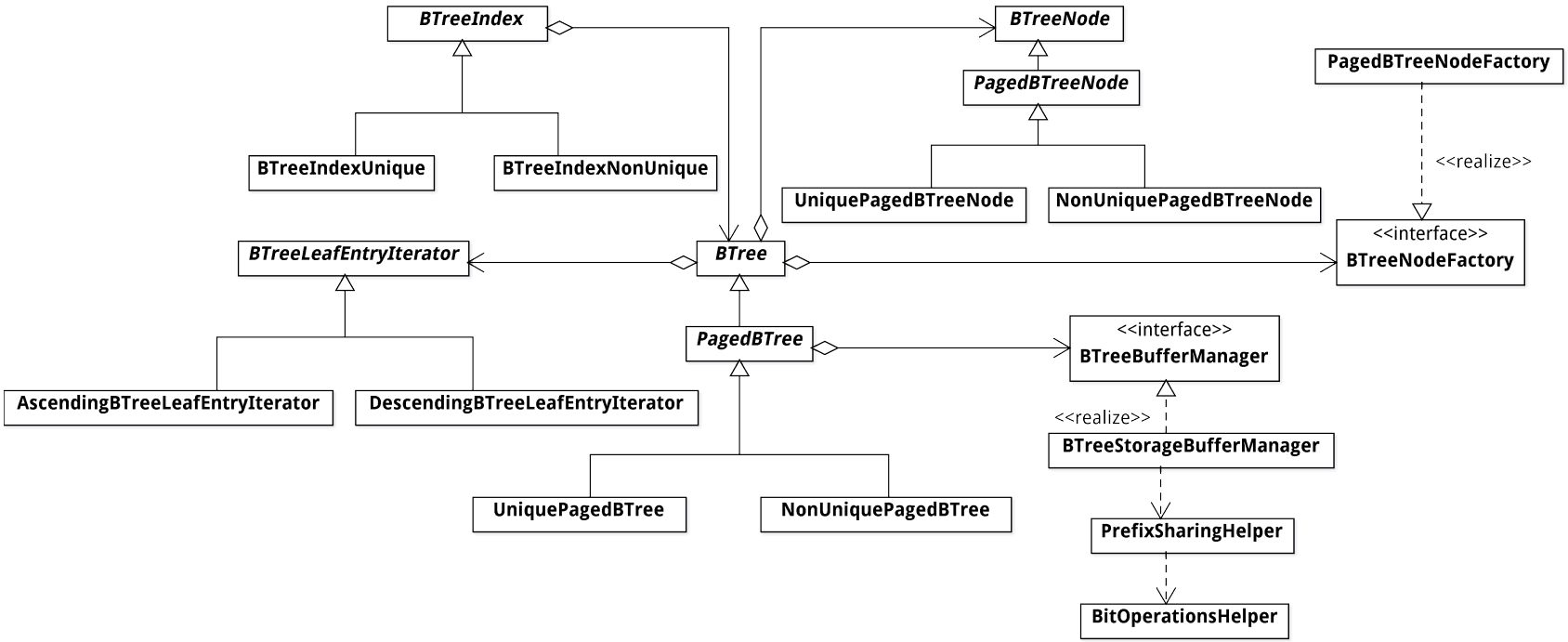
- low-level implementation optimizations

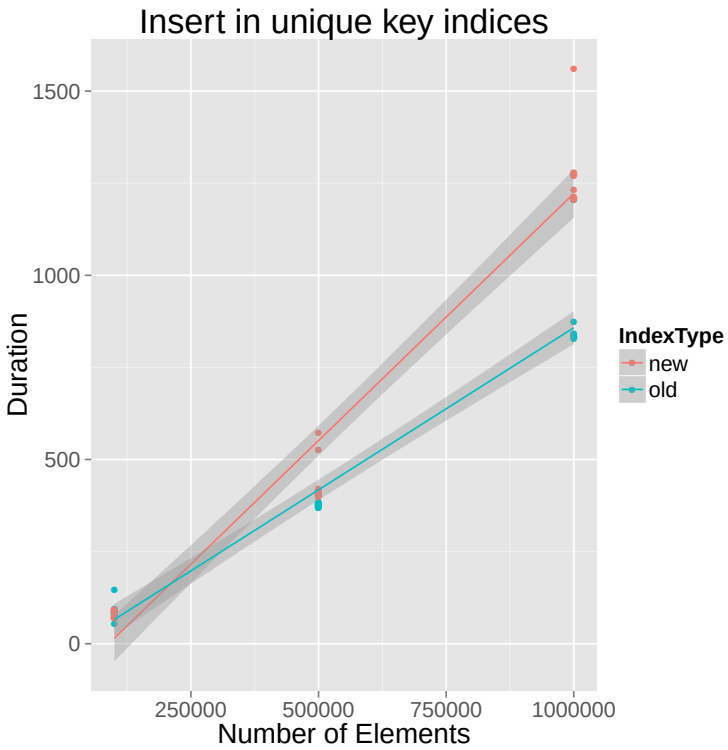
Index Implementation



Operations

- Search - Similar to normal B+ Tree
- Insert overflow
  - attempt to redistribute values to left sibling before creating a new node
- Delete underflow
  - check if possible to merge with left or right neighbour
  - check if possible to split current node between left and right
  - redistribute from left or right
- Write
  - only write dirty nodes
  - prefix encoding

Microbenchmarks



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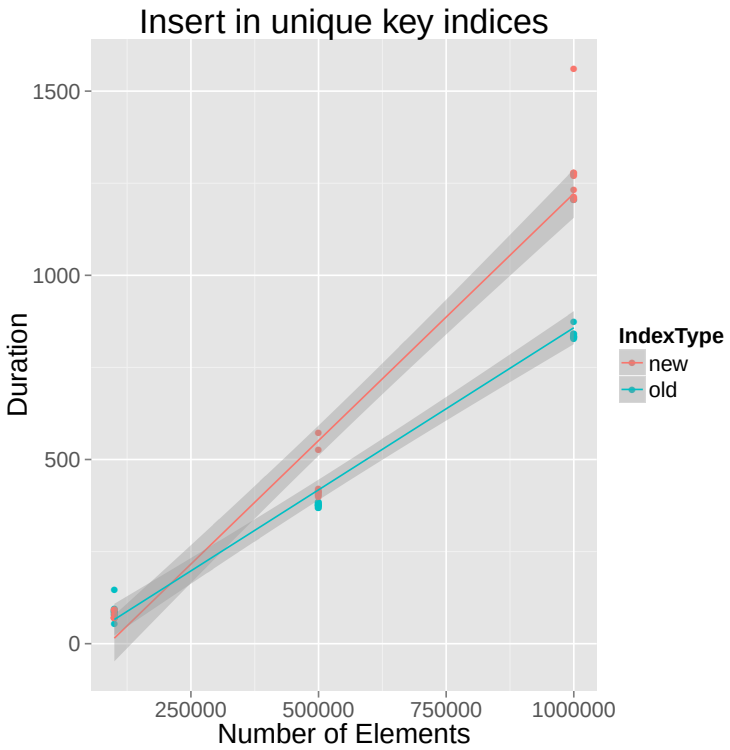

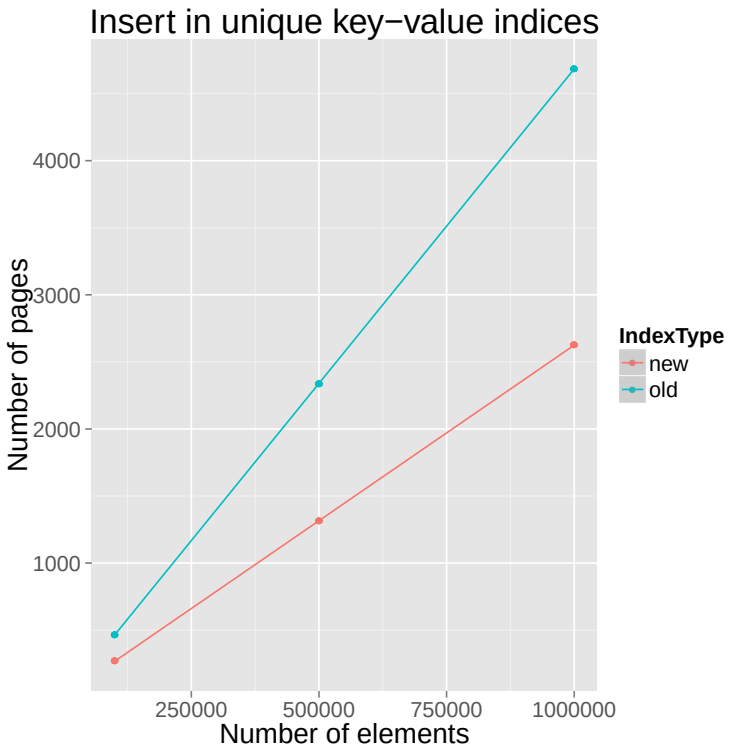

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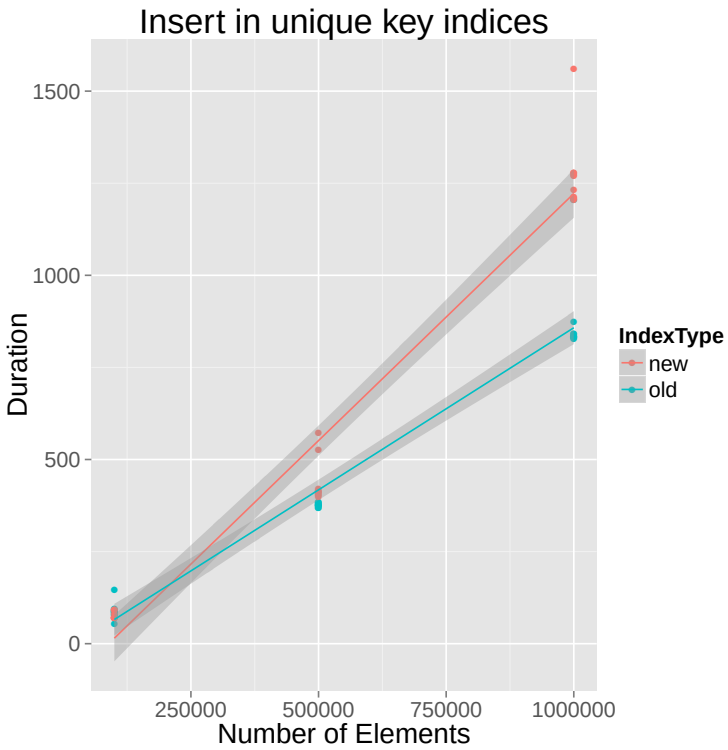

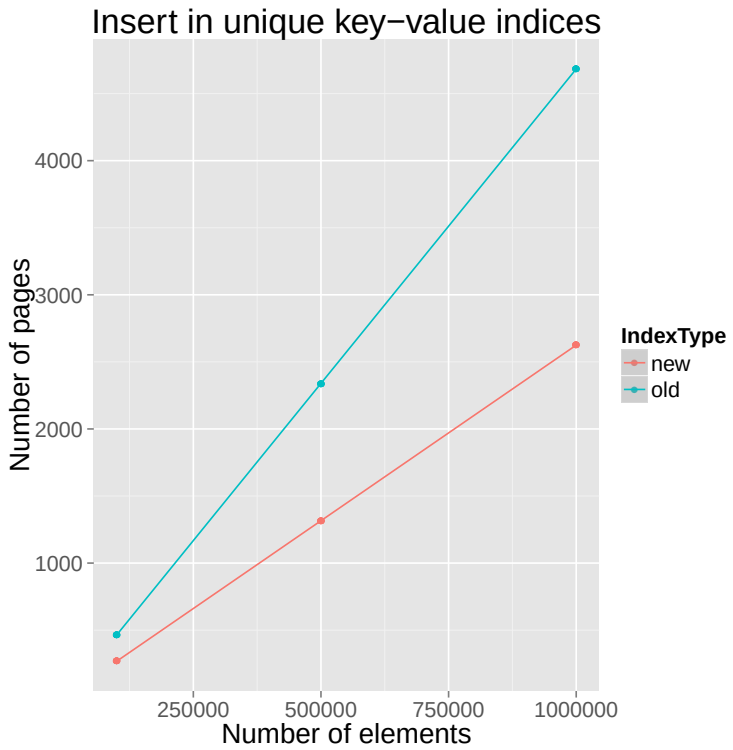

- in every microbenchmark the new index is significantly slower
- in most microbenchmarks there s a significantly lower number of nodes

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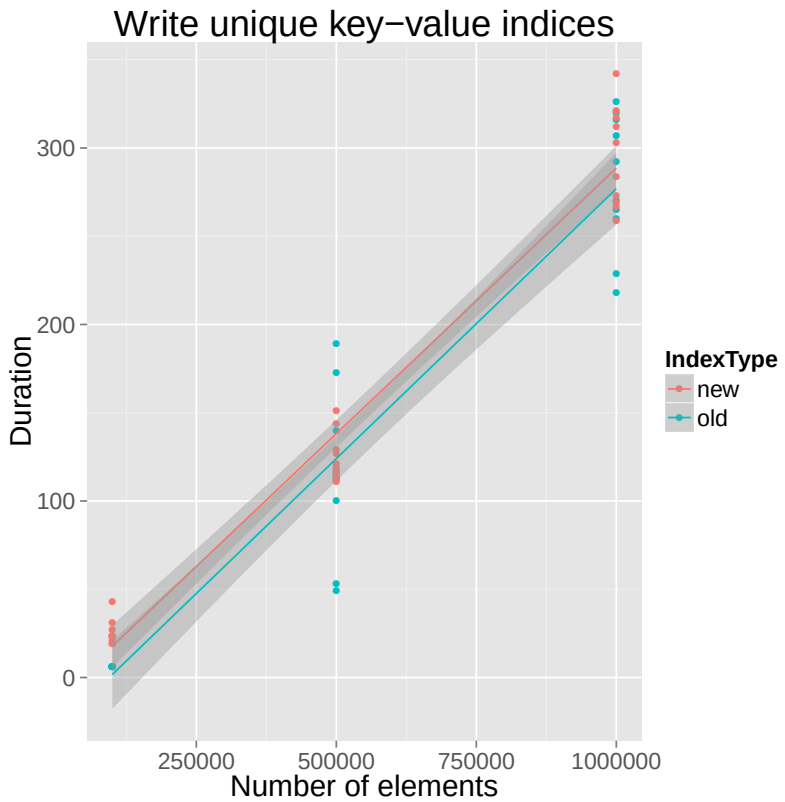

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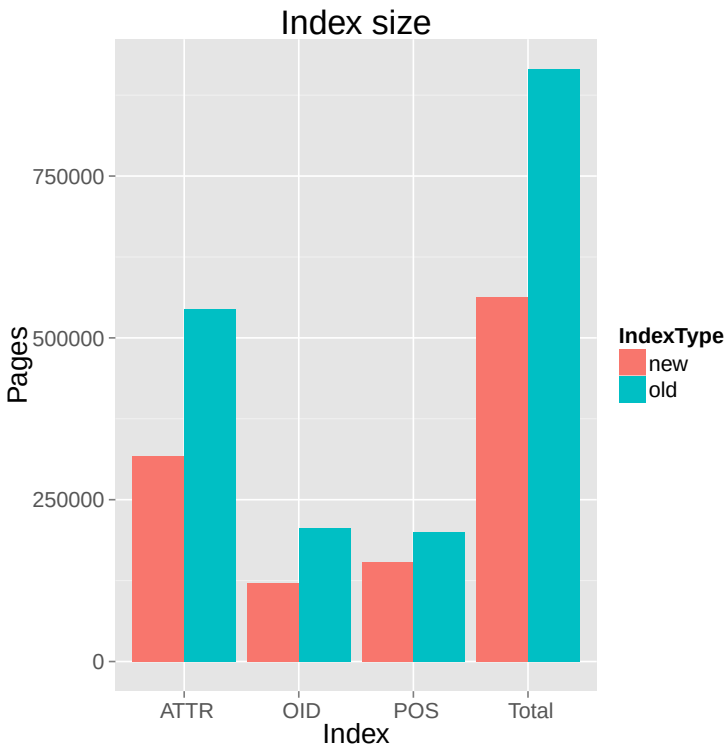

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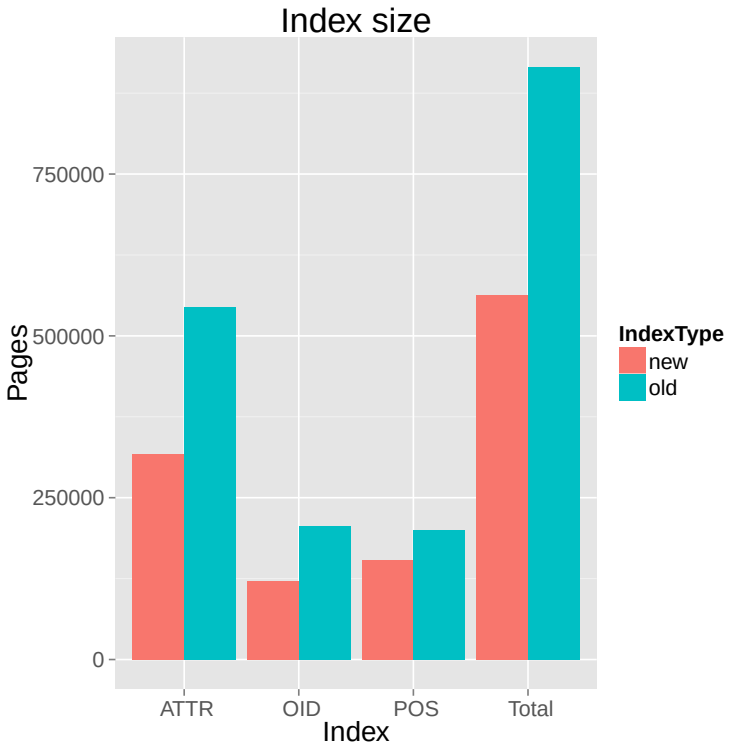

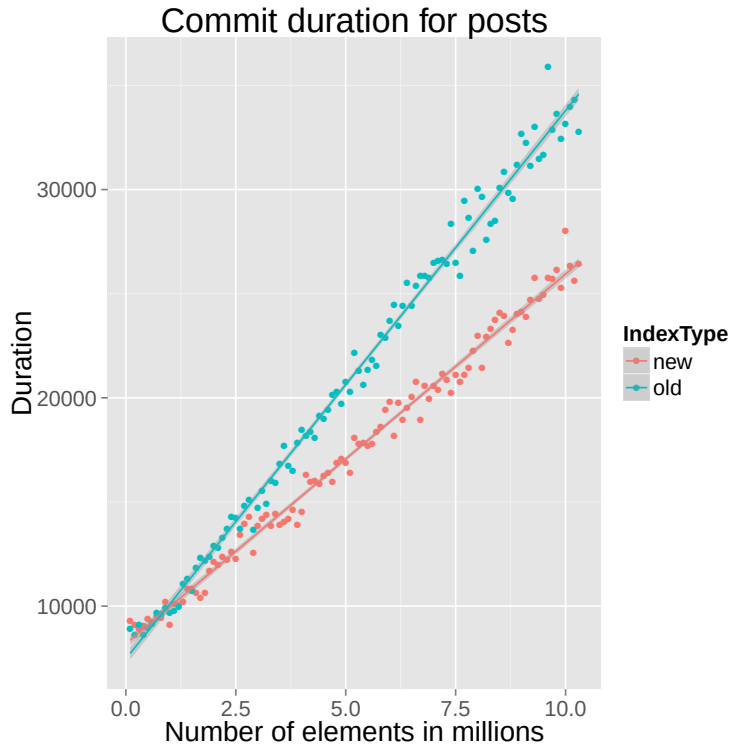

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- ...

Outlook

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