Designing an Index for ZooDB

Jonas Nick & Bogdan Vancea

June 2, 2014

Outline

- an open source object database written in Java

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- based on JDO standard

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Key-Value data structure

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Attribute Index
Value $\rightarrow$ Object-ID

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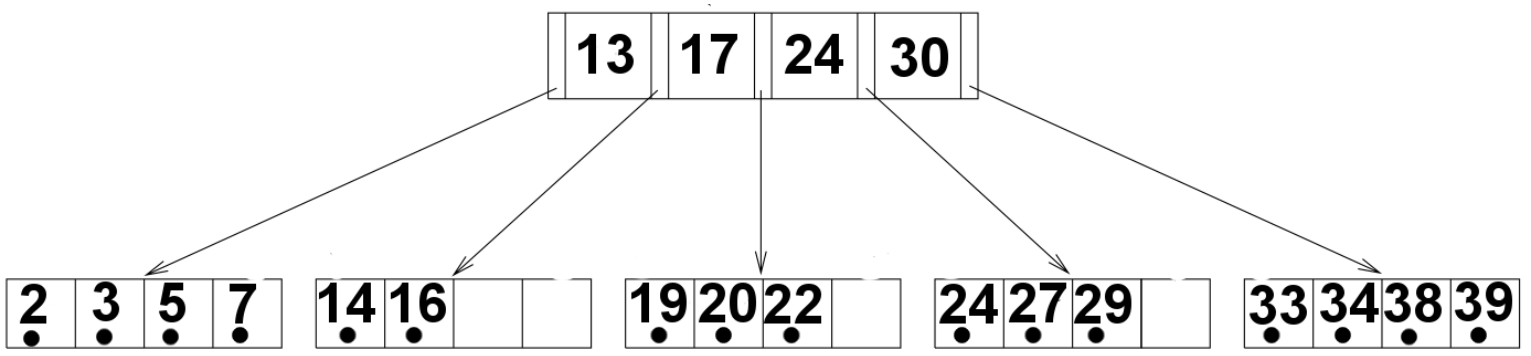
Attribute Index	**ObjectID Index**	**Extension Index**
Value → Object-ID	OID → Diskpos	Diskpos → 0|follow Diskpos

B+ Tree

Images adapted from Database Management Systems by Ramakrishnan and Gehrke.

B+ Tree



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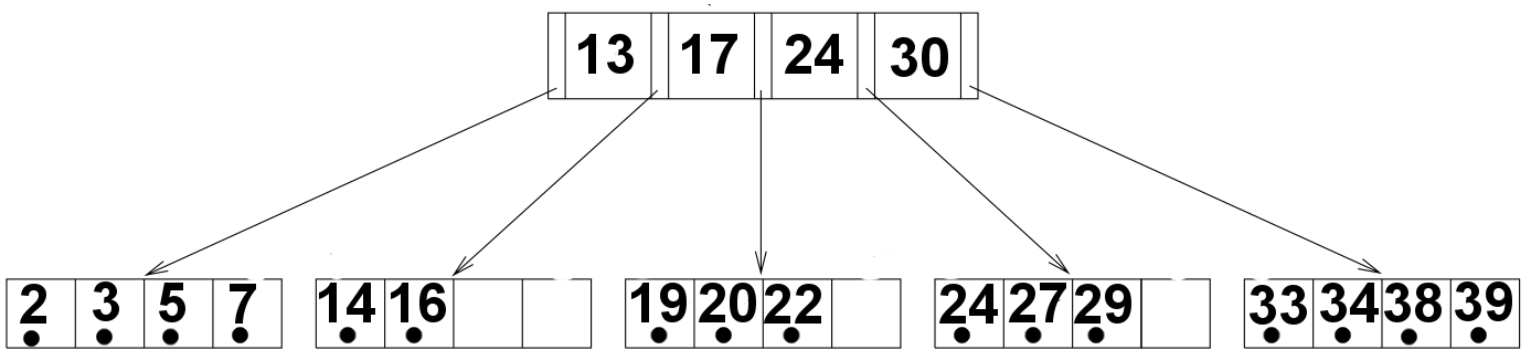

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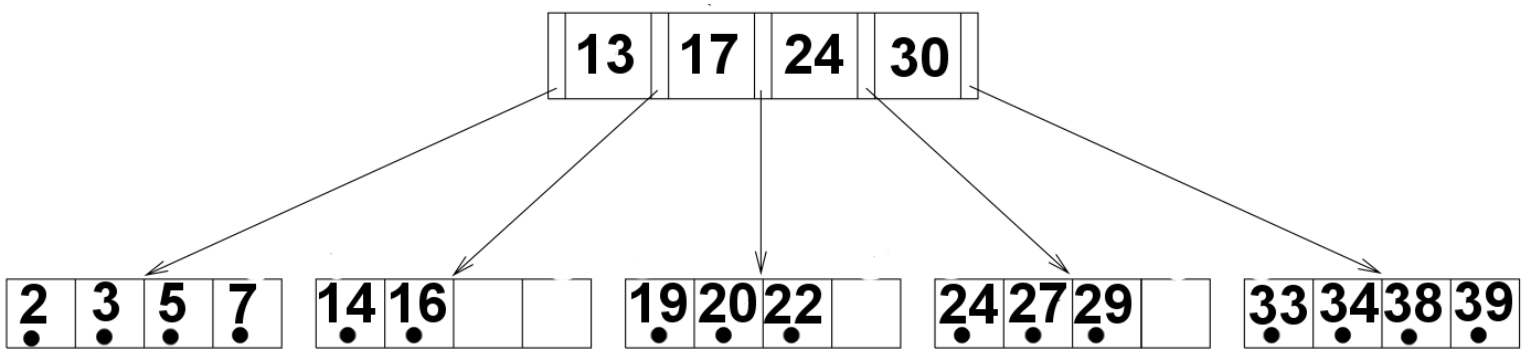

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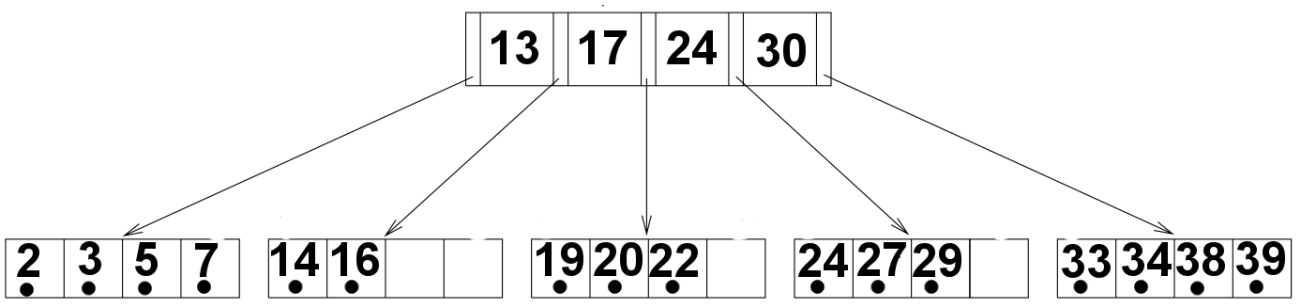

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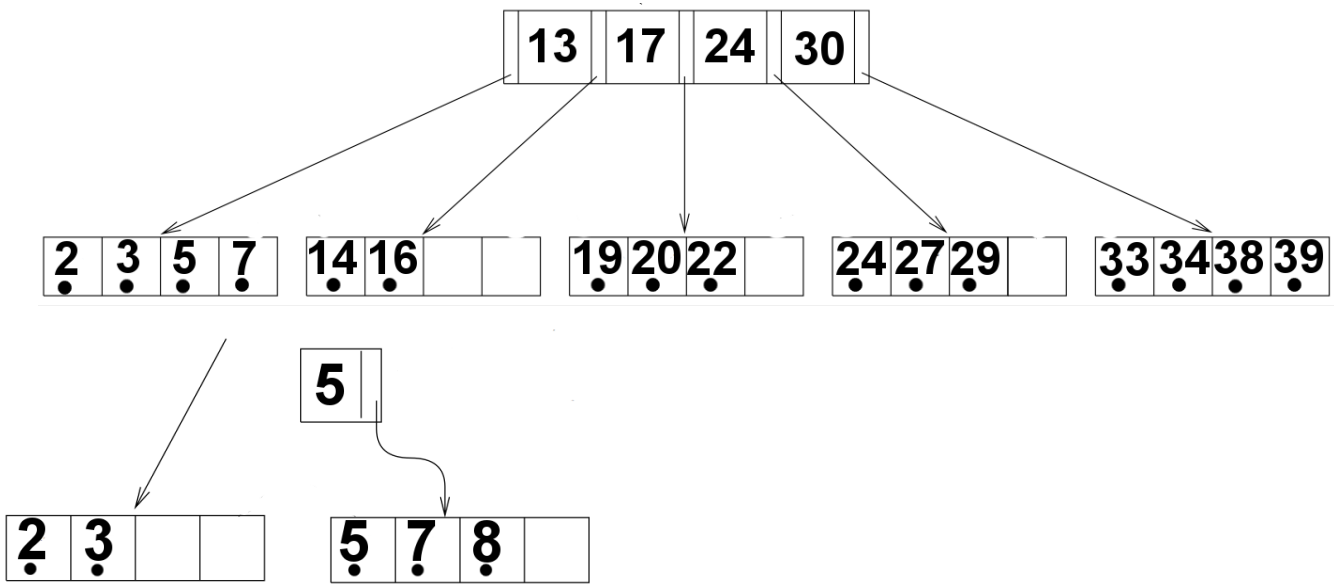

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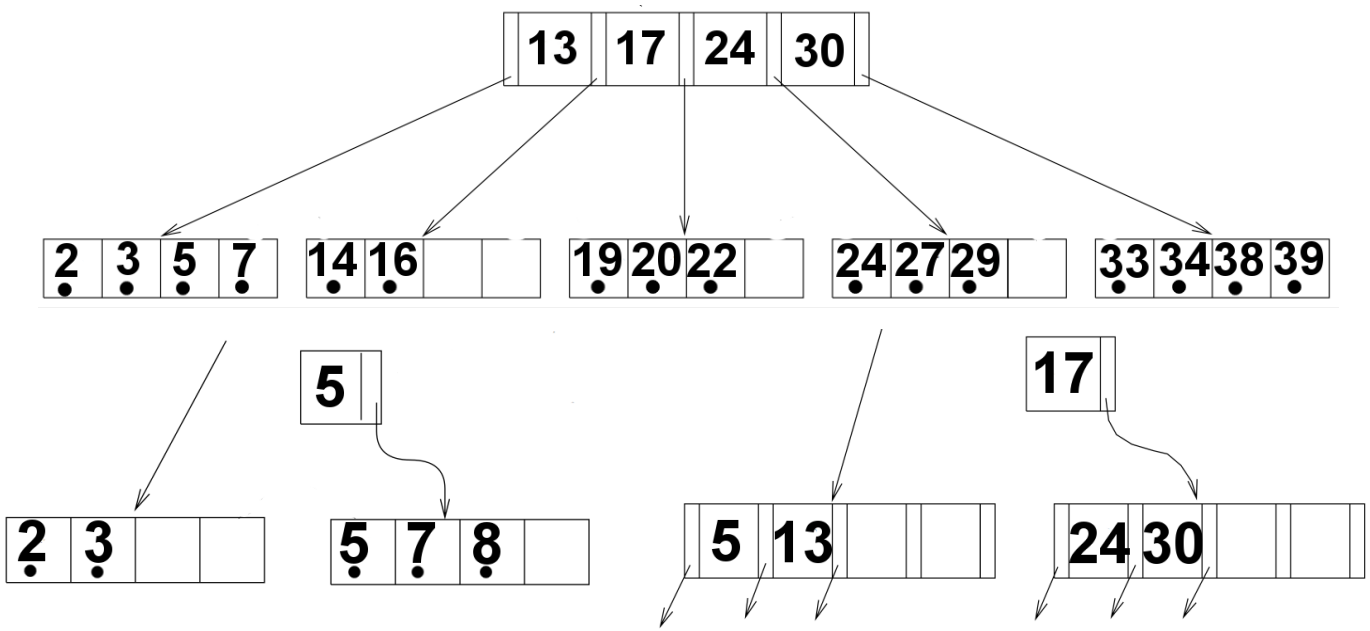

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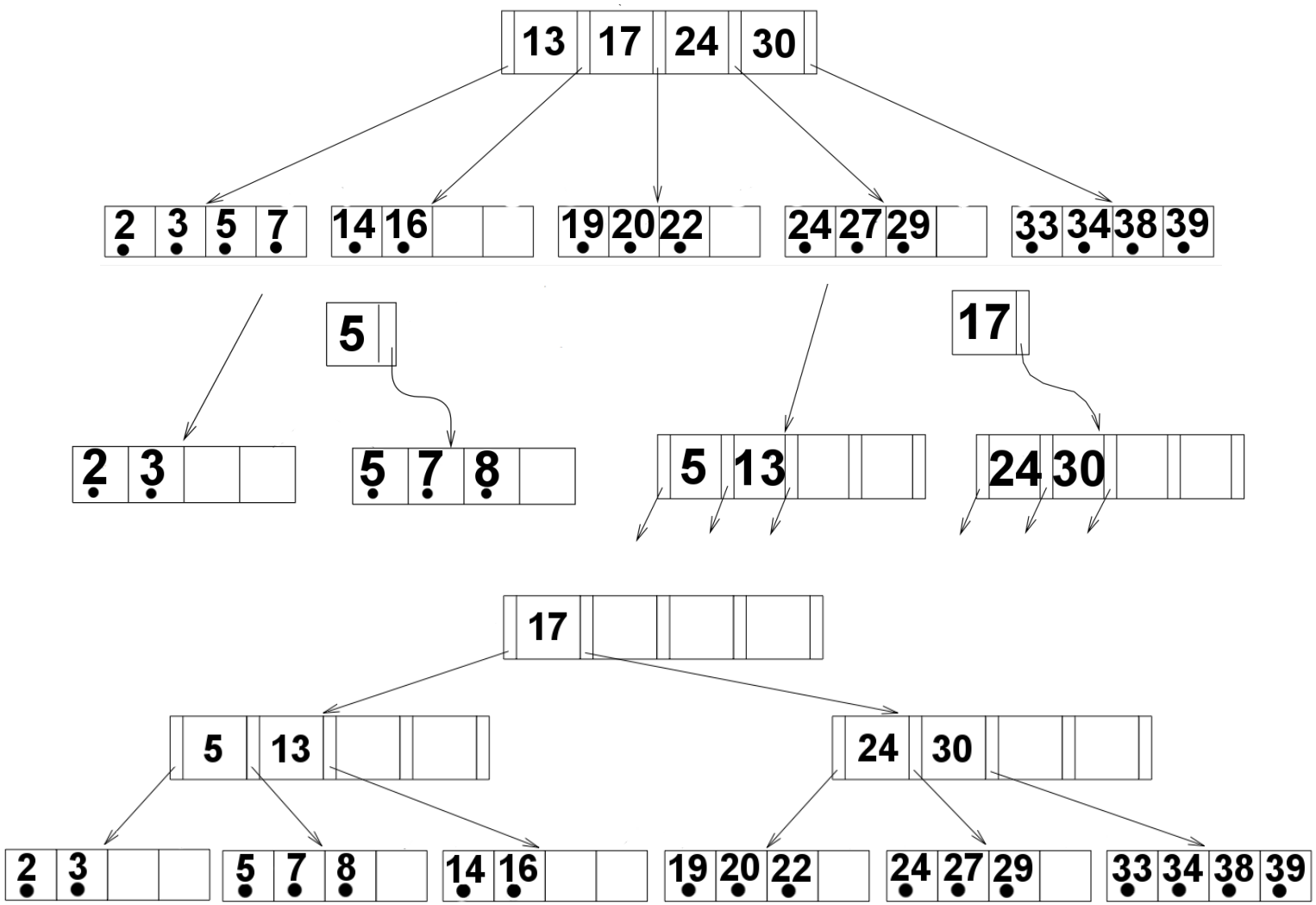

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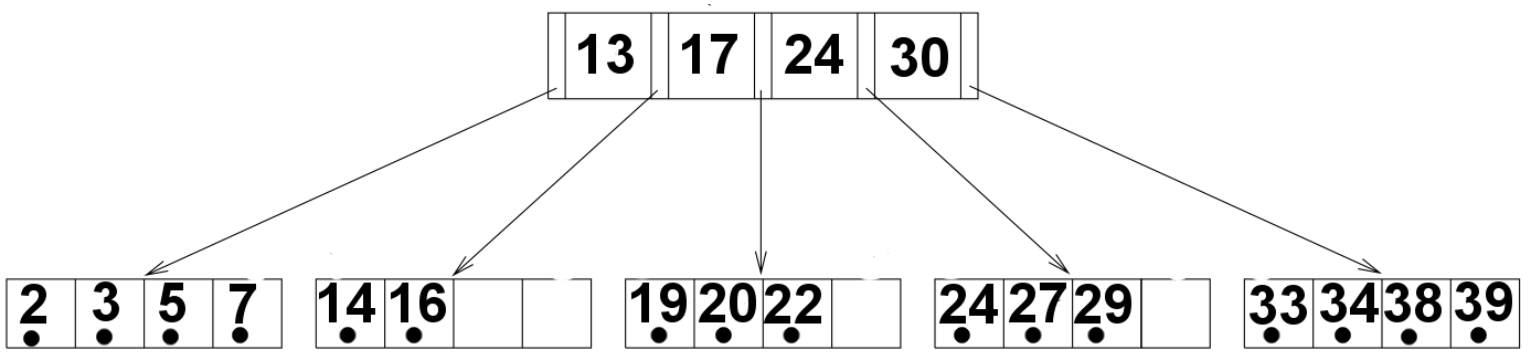

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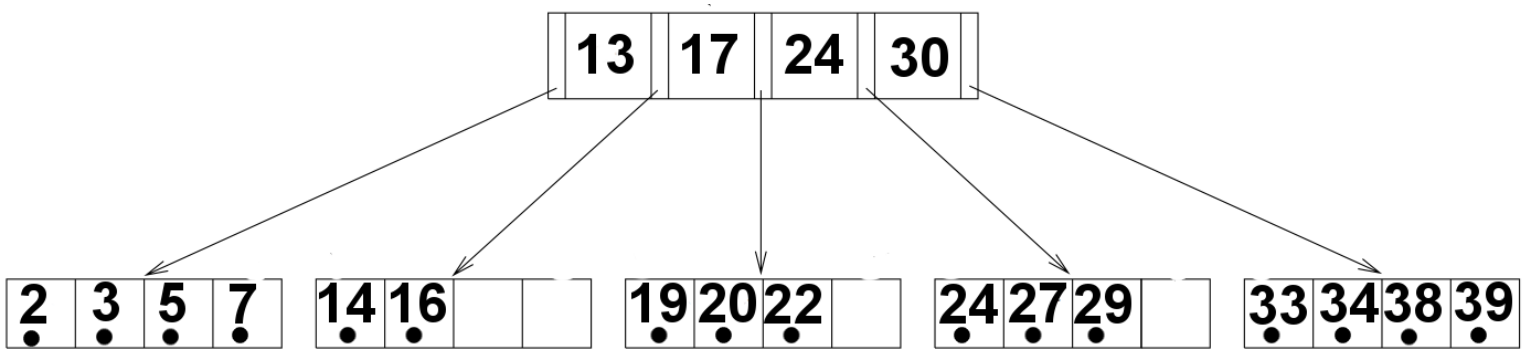

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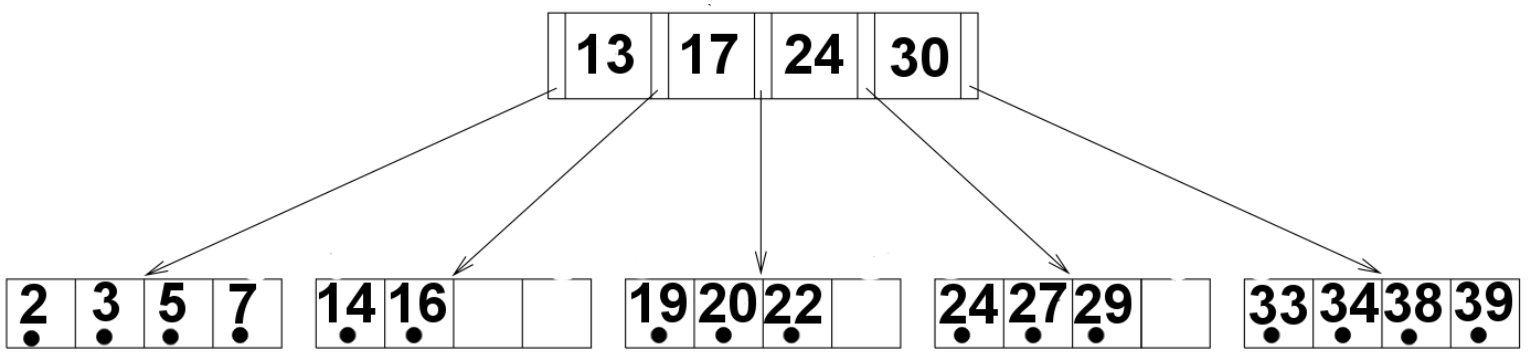

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- Insert, remove, search are logarithmic.

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Exploit common prefix

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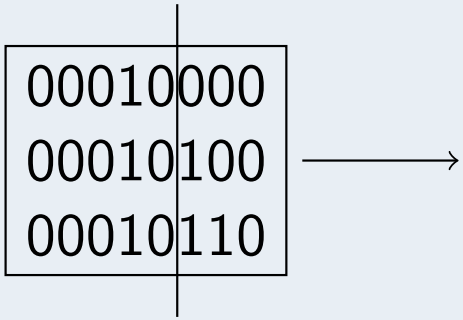

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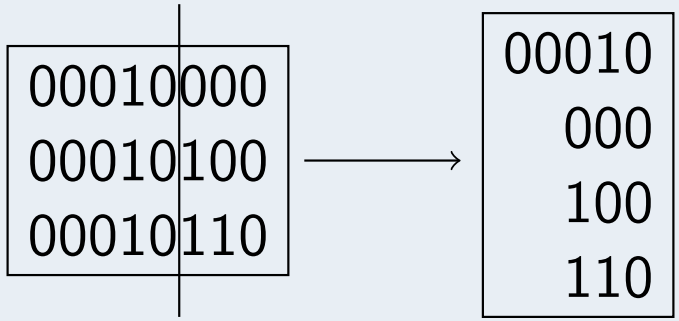

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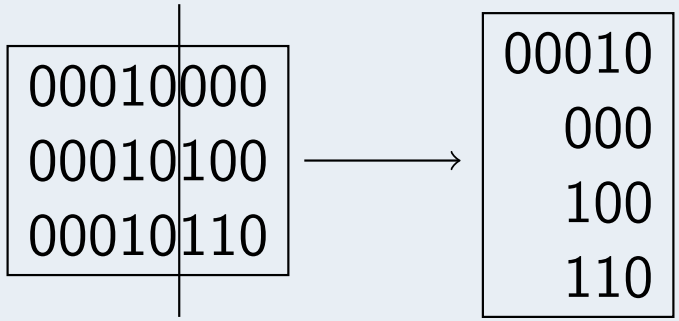

- allows storing more entries in a node
- determines if node under- or overflows

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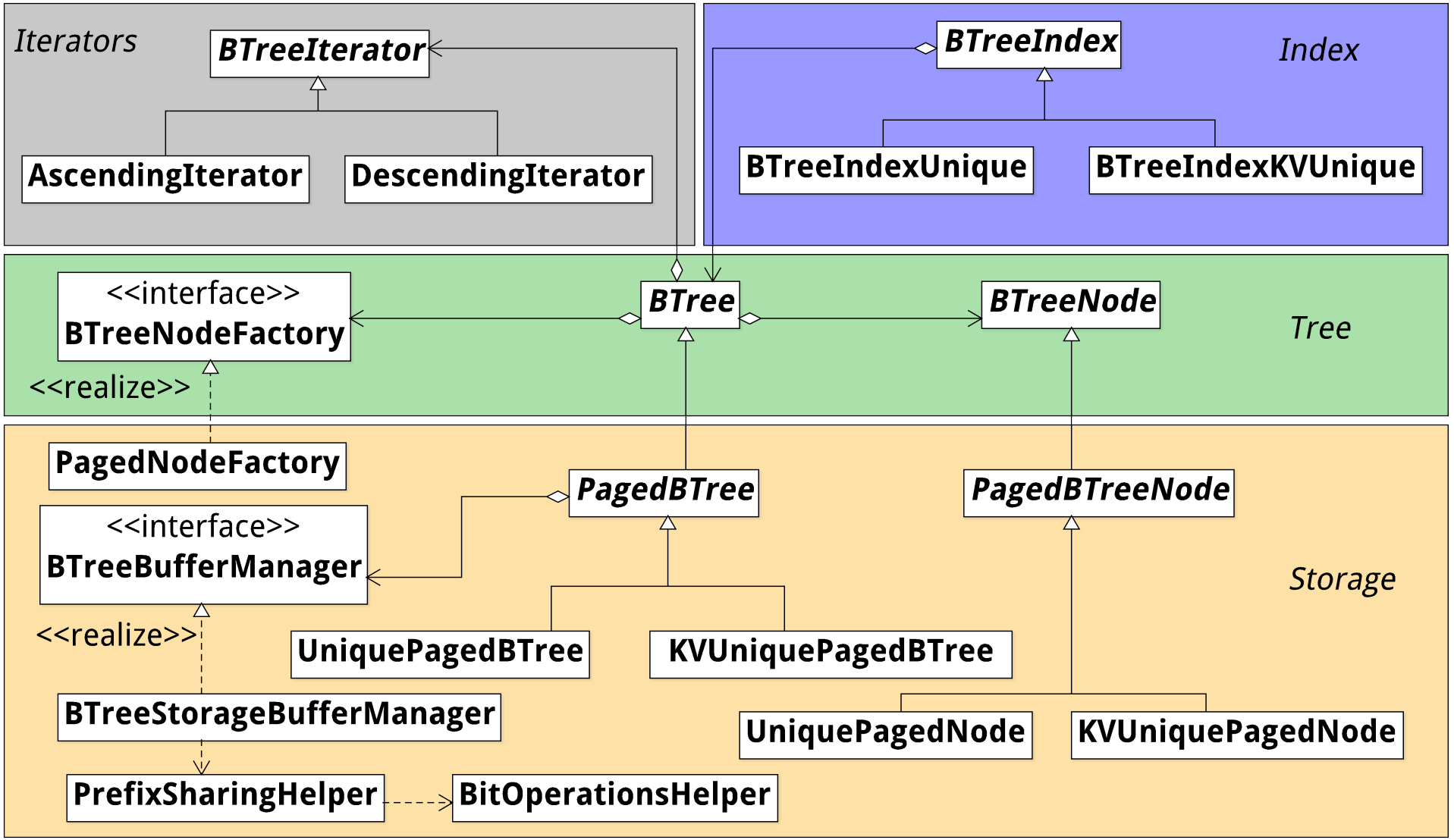
- low-level implementation optimizations

Index Implementation



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  - prefix encoding
- insert/delete more costly, exactly how much?

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Operation	No Prefix sharing	Prefix sharing
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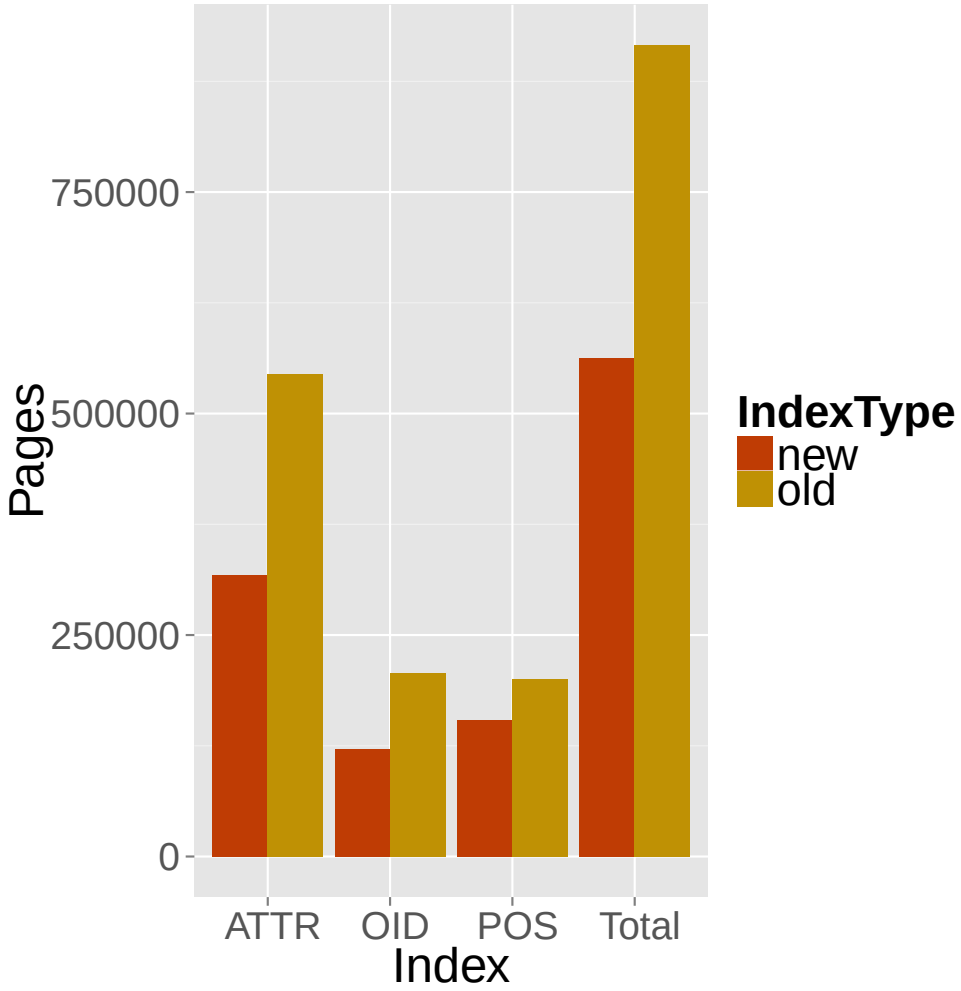
Size of B+ tree - Old index is the baseline

Operation	No Prefix sharing	Prefix sharing
Insert	1	0.5 - 1.1
Delete	1	0.5 - 0.75

StackOverflow Data Import

- real-world workload
- StackOverflow data
  - 1.3 million users
  - 10.3 million posts
  - 13 million comments
  - 25 million votes
- 3 key unique attribute indexes
- 9 key-value unique attribute indexes

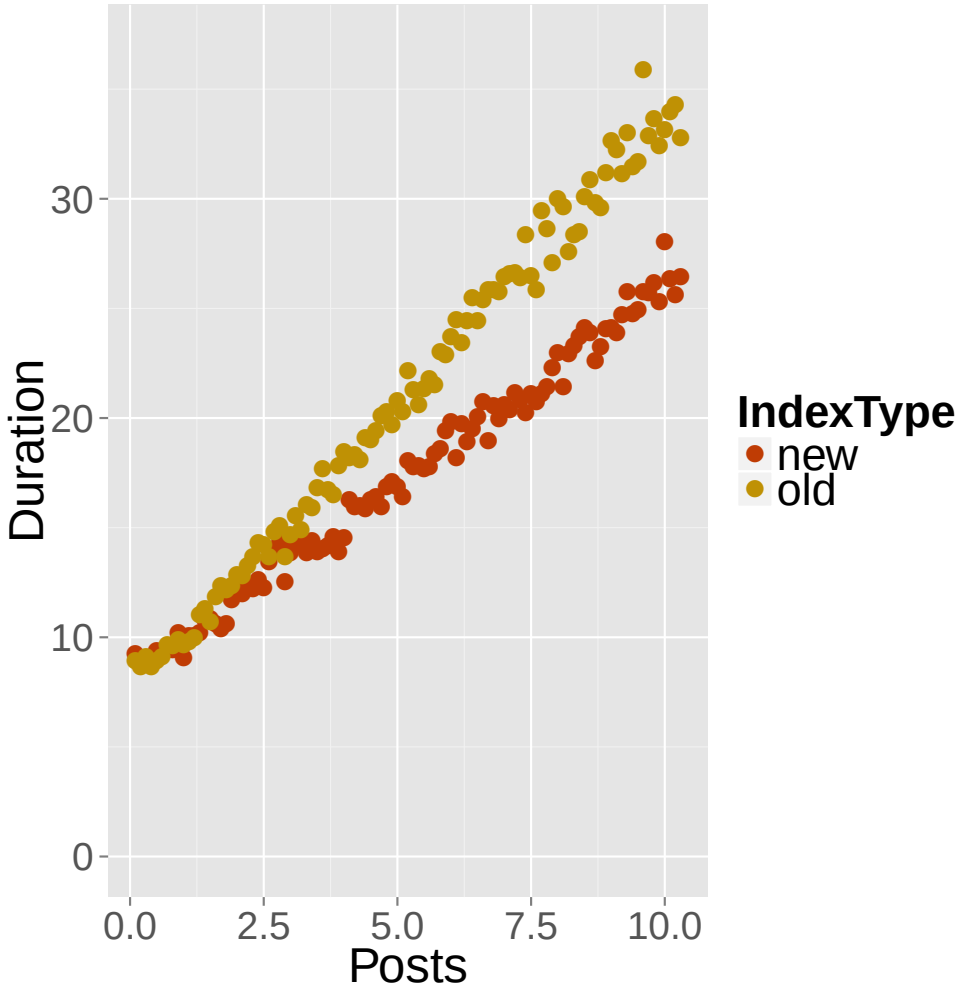
StackOverflow Import - Index Sizes



- page size: 4KB
- database size: 31 GB

Index	**Space saving** (%)
Atrribute	41.6
OID	41.5
POS	23.1
Total	38.5

StackOverflow Import - Commit times



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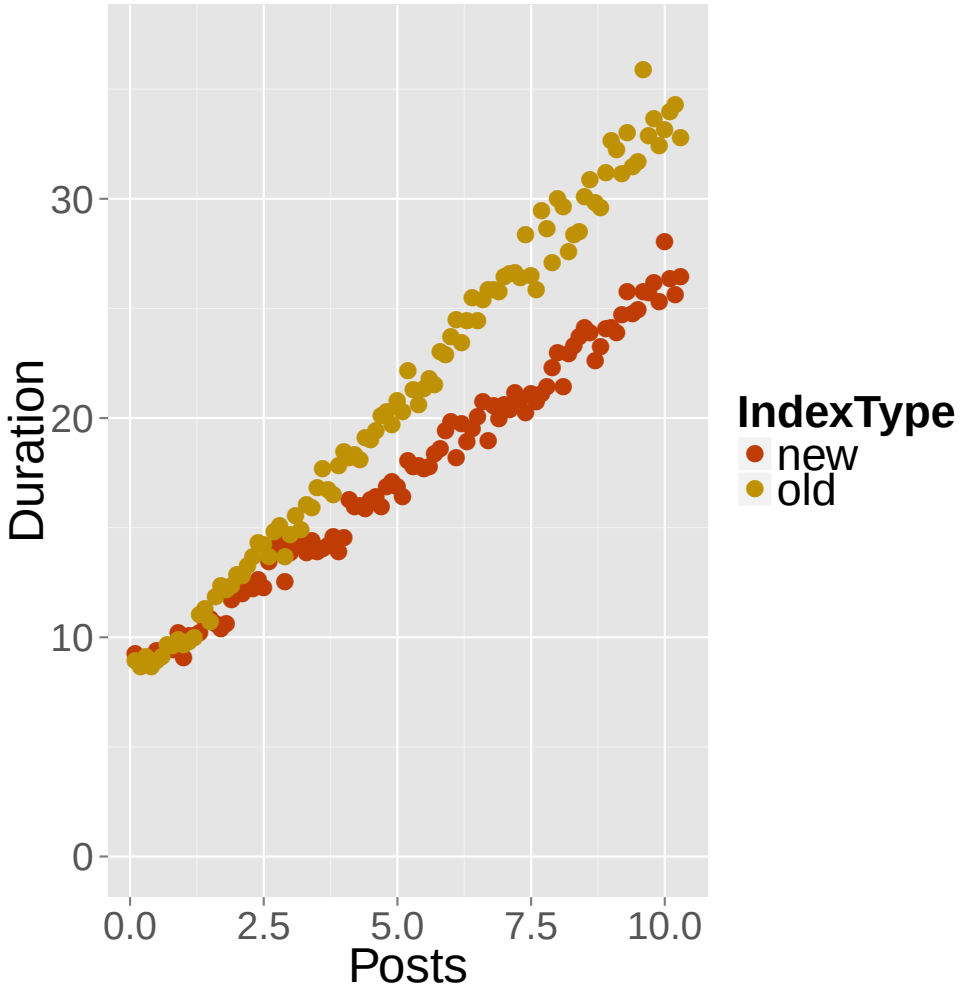

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- why?
- more entries in a node
  $\rightarrow$ fewer dirty nodes
- data locality

Summary

- prefix sharing: trade-off between speed and space
- works well in practice
- microbenchmarks
- implementation complexity.

Q&A

- Thank you for your attention!
- Questions ?