Designing an Index for ZooDB

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Outline

ZooDB
The JDO Database

- an open source object database written in Java

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Key-Value data structure

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Attribute Index
Value $\rightarrow$ Object-ID

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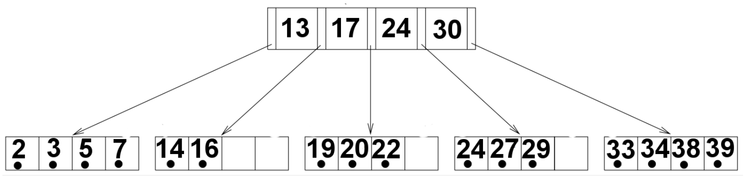
Attribute Index Value → Object-ID	**ObjectID Index** OID → Diskpos	**Extension Index** Diskpos → 0|follow Diskpos

B+ Tree

Images adapted from Database Management Systems by Ramakrishnan and Gehrke.

B+ Tree



- Inner node contains keys and children pointer, leaf contains keys and values.

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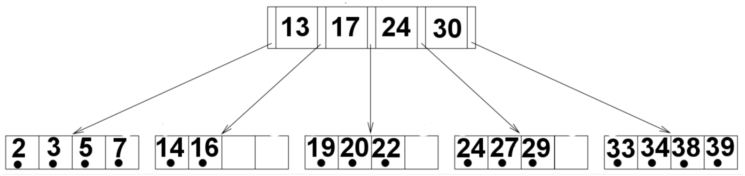

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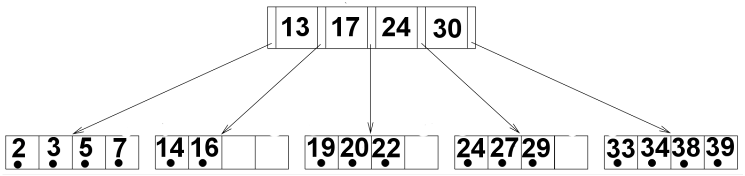

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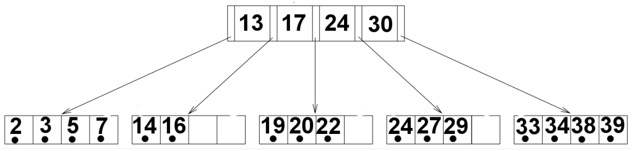

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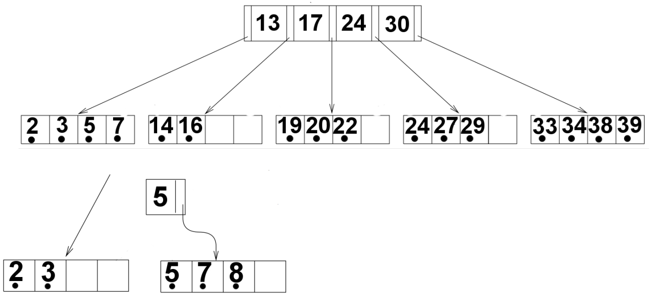

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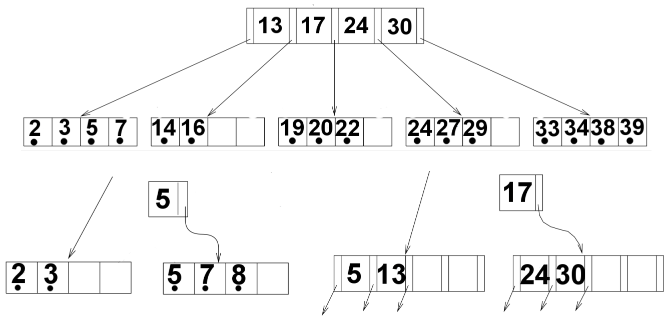

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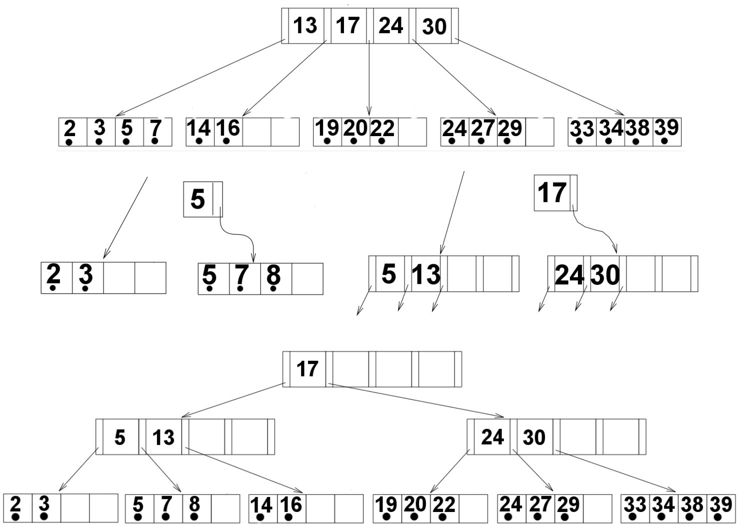

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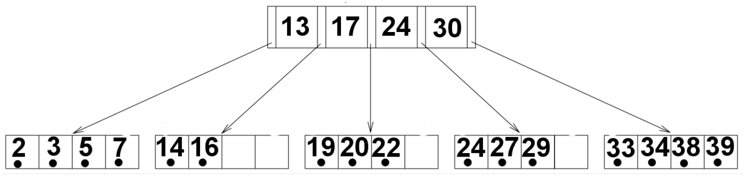

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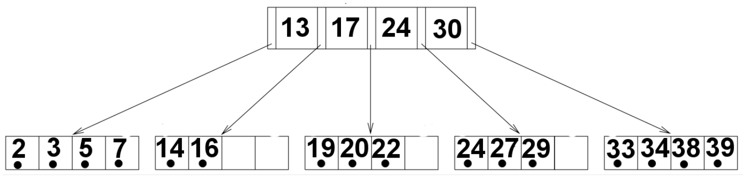

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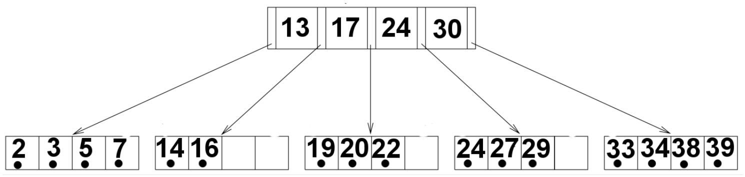

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- Insert, remove, search are logarithmic.

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Prefix Sharing

Exploit common prefix

```
00010000
00010100
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```

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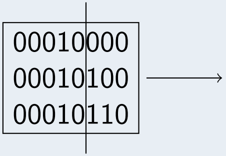

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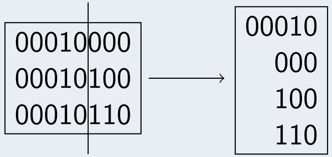

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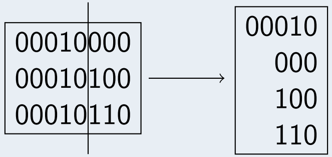

- allows storing more entries in a node
- determines if node under- or overflows

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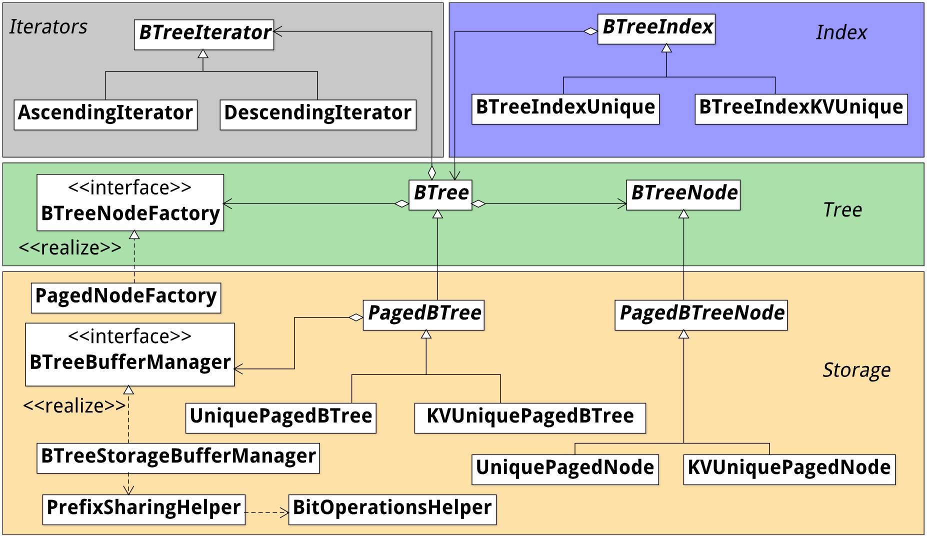
  1. not optimized for our practical scenario
  2. do not cover prefix sharing nor duplicates
- low-level implementation optimizations

Index Implementation



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  - only write dirty nodes
  - prefix encoding
- insert/delete more costly, exactly how much?

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Operation	No Prefix sharing	Prefix sharing
Search	1	0.9 - 1.1
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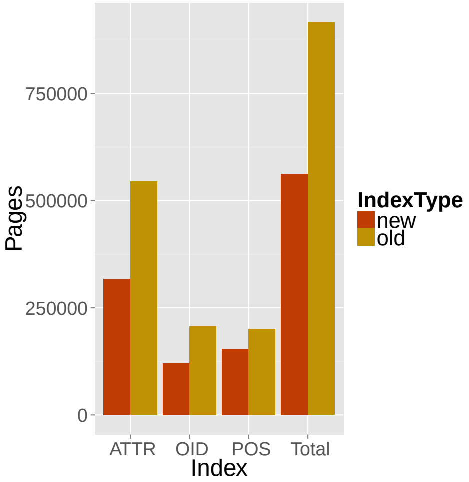
Size of B+ tree - Old index is the baseline

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

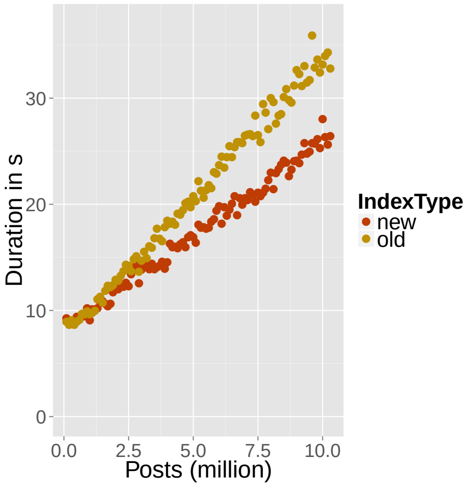
StackOverflow Import - Index Sizes



- 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



- import with new index 25% faster
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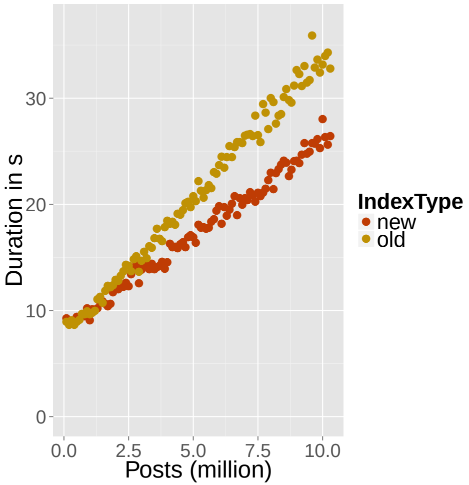

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- more entries in a node $\rightarrow$ fewer dirty nodes
- data locality

Summary

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

Q&A

- Thank you for your attention!
- Questions ?