# Designing an Index for ZooDB

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# Outline

1 Introduction

2 The new Index Implementation

3 Benchmarks

# ZooDB

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

# Database Index

Key-Value datastructure that allows for ordered iteration.

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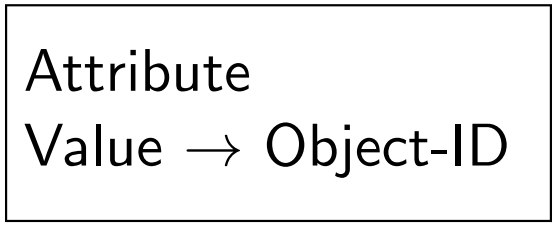

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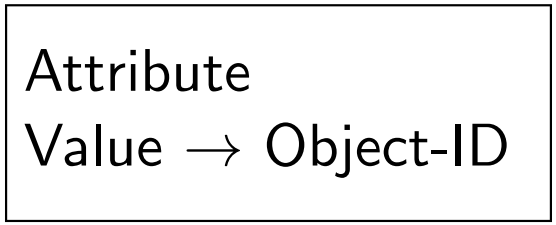
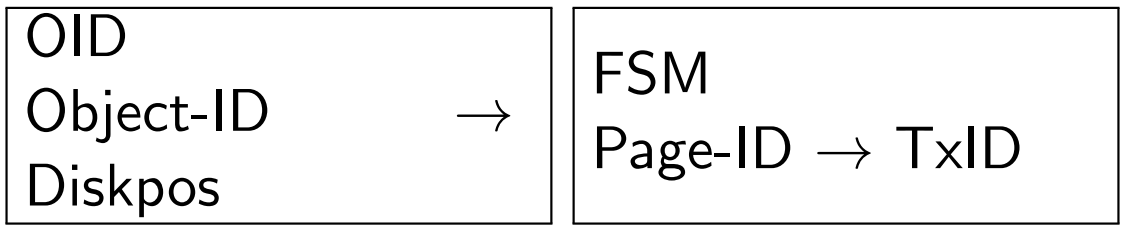
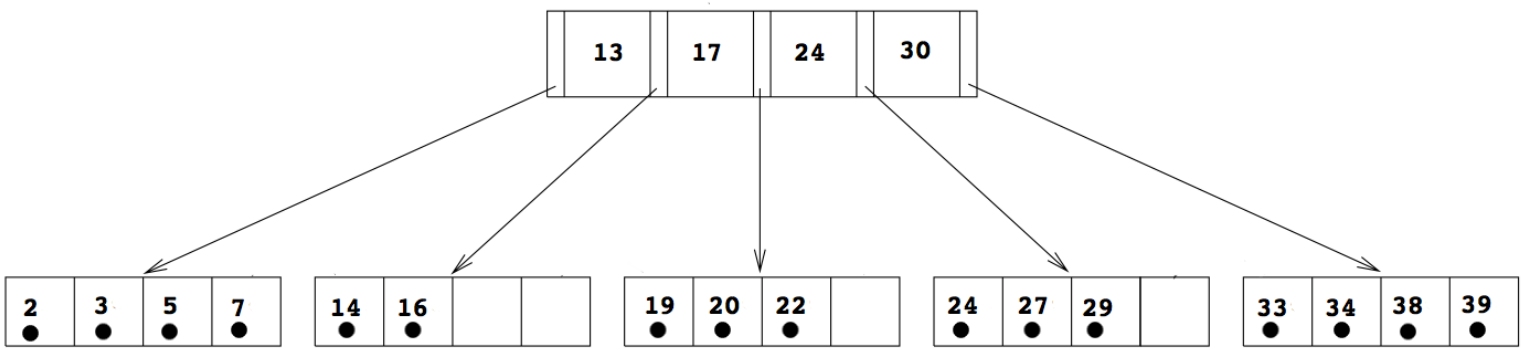


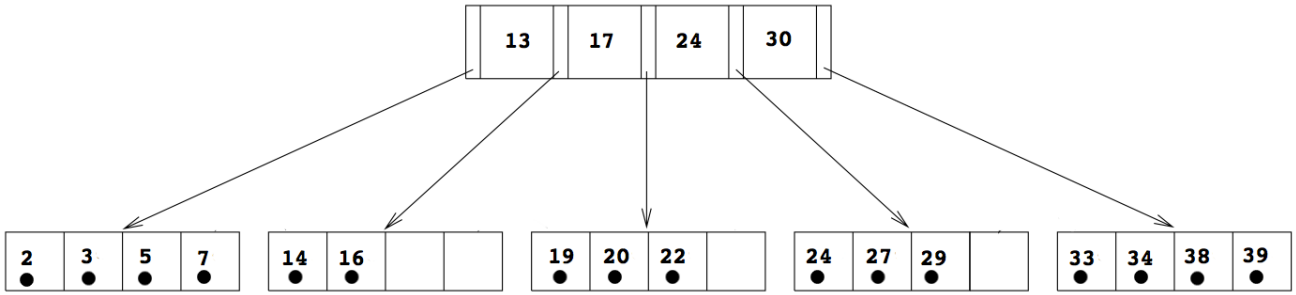



# B+ Tree




- node fills one disk page
- inner node contains keys and children pointer, leaves contain keys and values
- key unique vs. key-value unique

# Example: insert $(8, v)$



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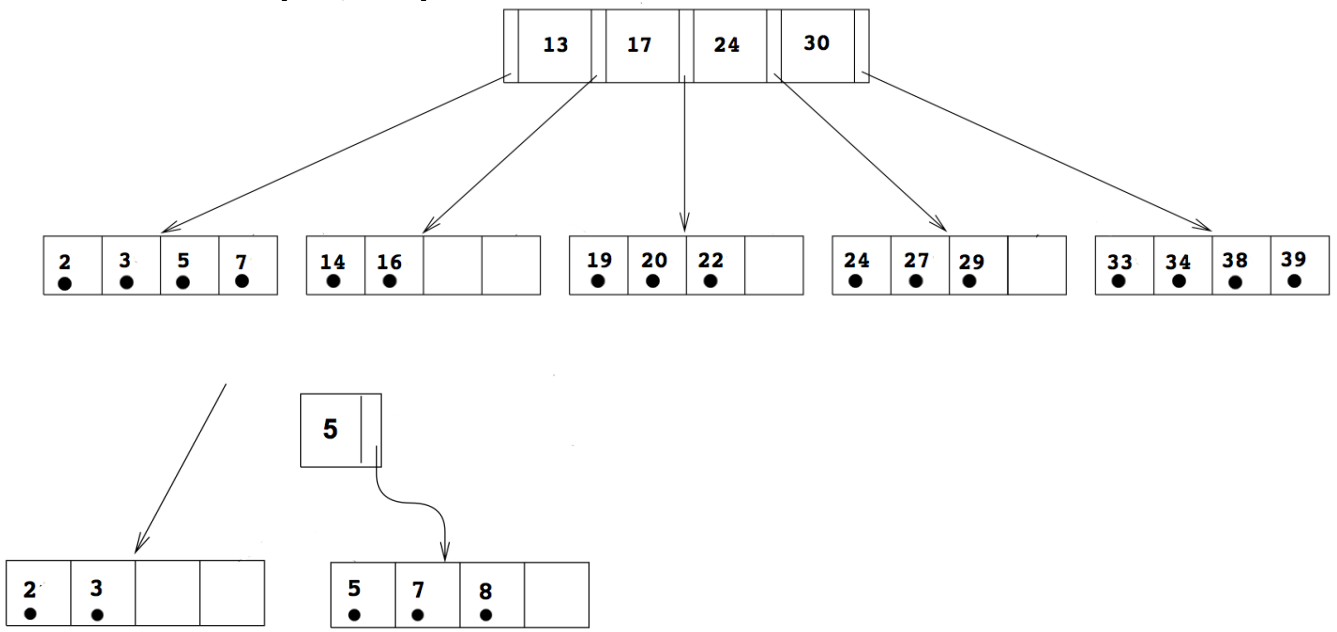

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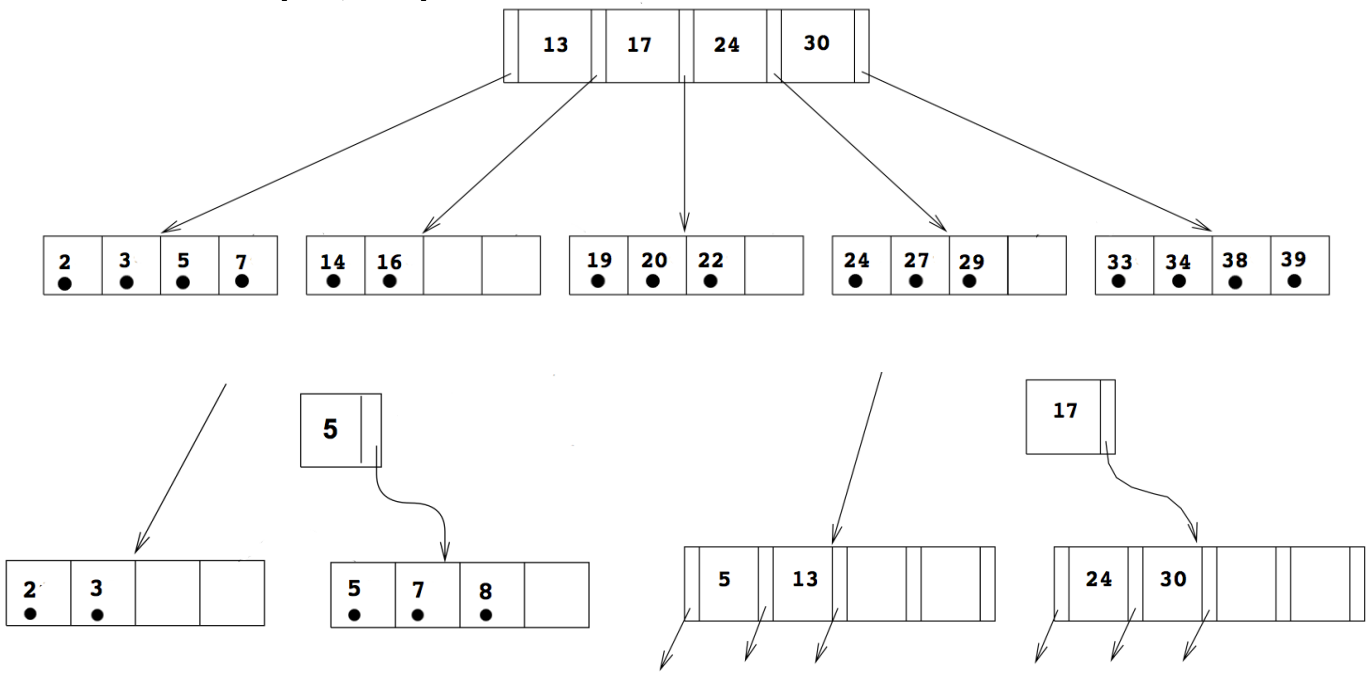

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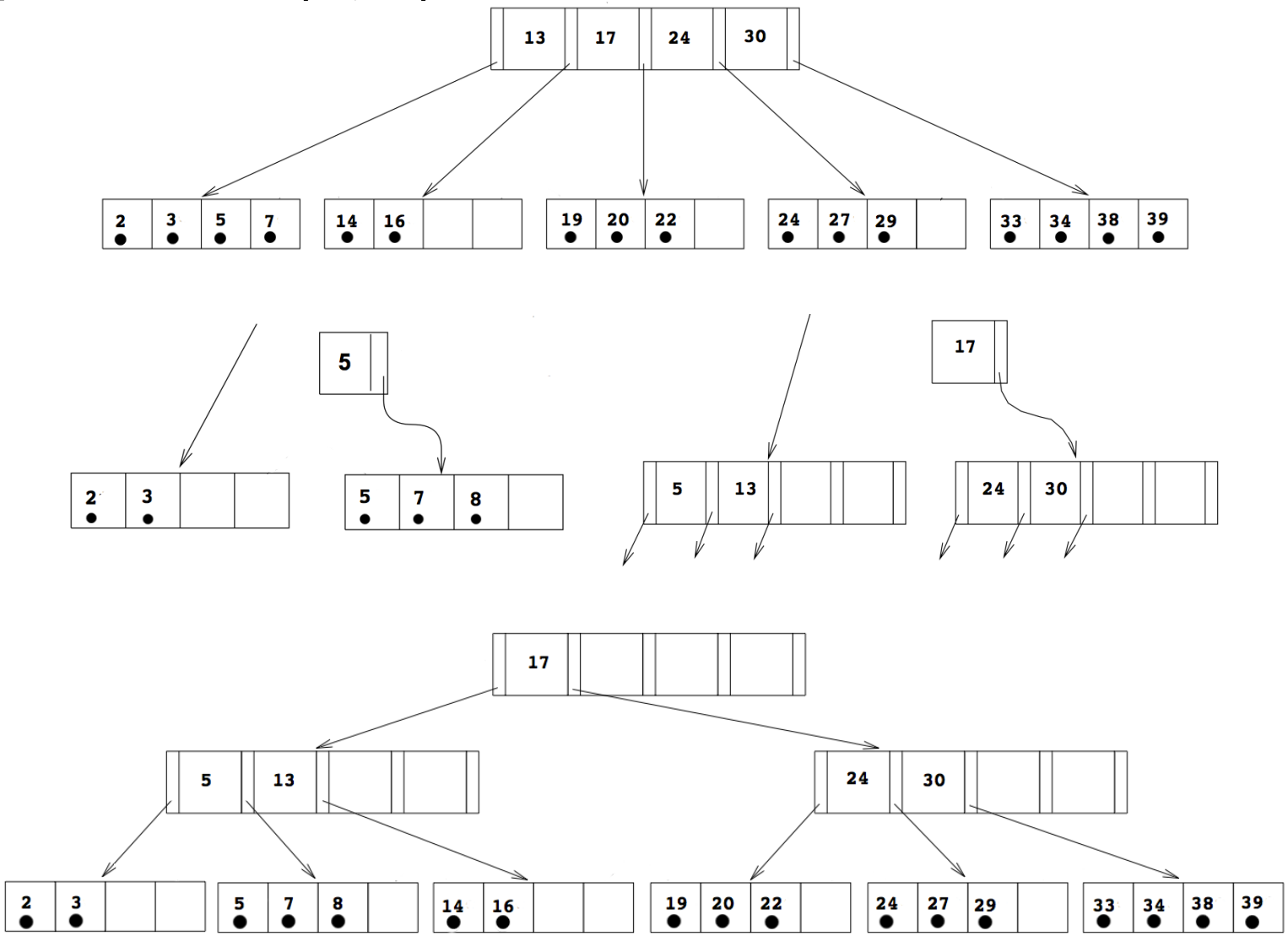


3908 loc + 2665 loc of test

# Goals

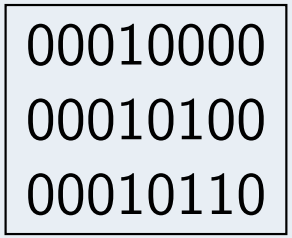
- fast B+ tree index
- buffer manager to allow caching
- prefix sharing

# Challenges - General

- edge cases
- runtime dominated by disk access
  - change nodes infrequently
  - fewer nodes is better
- only parent to child pointer
- determine best when its time to split/redistribute
- key unique vs. key-value unique
- buffer manager lookup takes time
- prefix-sharing encoding/decoding takes time
- prefix-sharing rebalancing takes time
- general optimizations
  - avoid polymorphism
  - bit-level operations

# Prefix Sharing

## Exploit common prefix of keys in nodes



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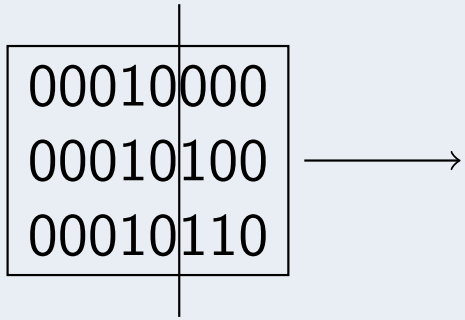

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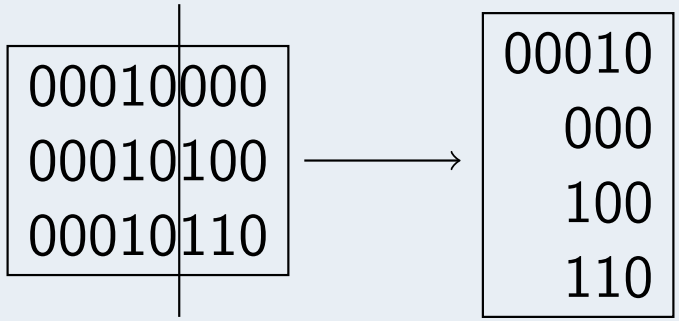

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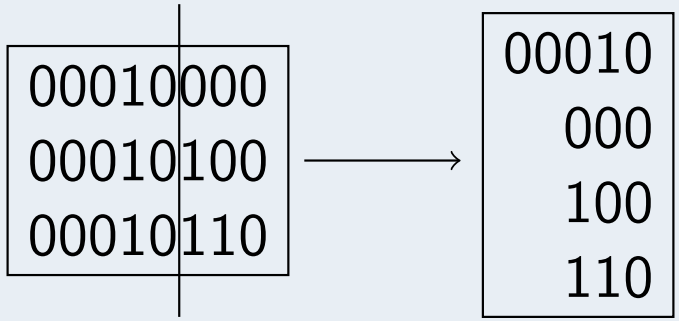
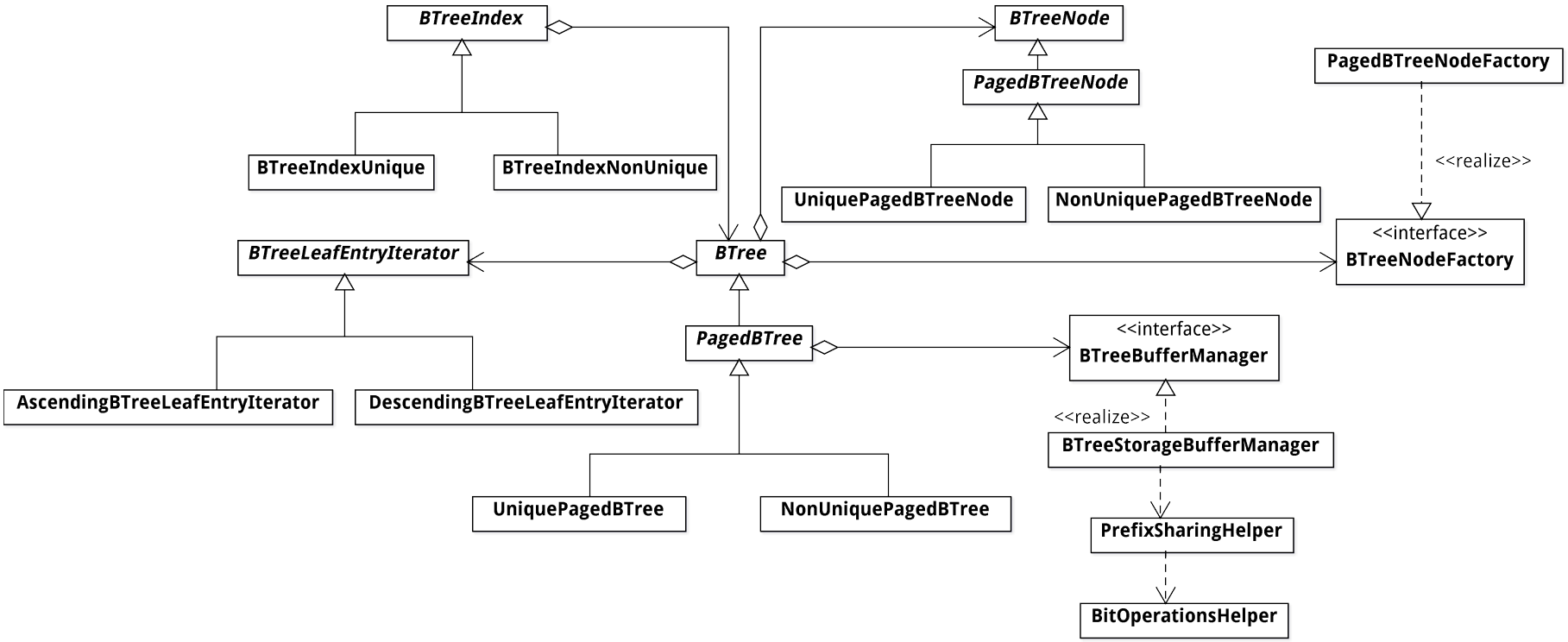



- variable number of key-value entries per page
- prefix determines
  - if 2 nodes can be merged without overflow
  - the number of entries that can be redistributed from one node to the other

# Our B+ Tree

- 64 bit keys and 64 bit values
- key unique and key non-unique variants
- keys encoded based on common bit prefix

# Class Diagram



# 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

# Fine grained

- insert, remove, write
- duration, number of nodes
- prefix-sharing vs. no prefix-sharing

# Whole system

- test harness
- partial PolePosition benchmark
- StackOverflow

# Summary

- ...

# Outlook

- ...