FloDB: Unlocking Memory in Persistent Key-Value Stores

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Introduction

Key-value (KV) stores - very widespread

Online shopping Messaging Advertising

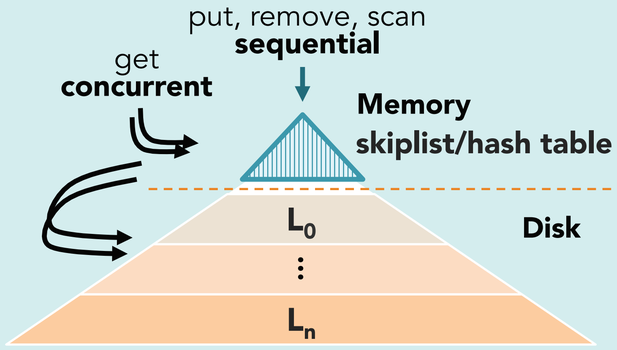
LEVELDB cassandra redis RocksDB mongoDB

LSMs = classic solution for persistent KV stores

LSM structure

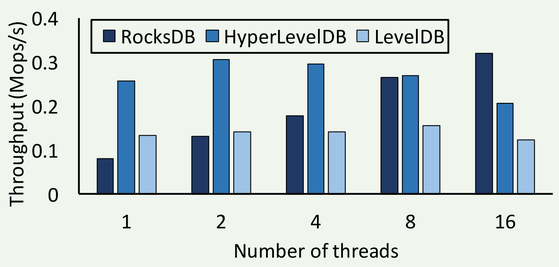
Two components:

- **Memory**
  fast; absorbs updates.
- **Disk**
  persists data in background.

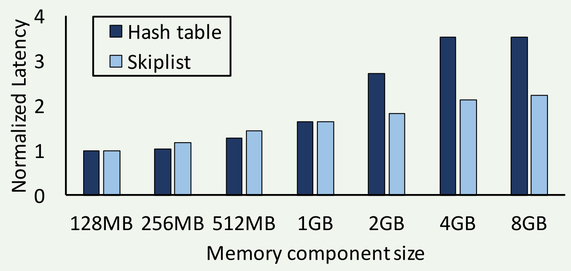


LSM memory components have inherent **scalability limitations.**

Limitation 1:
Scalability with threads



Limitation 2:
Scalability with memory size

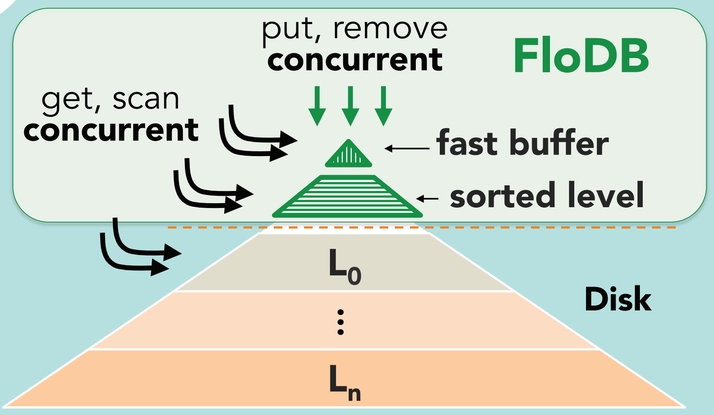


Objectives

Design a **memory component** for LSMs that:

- Scales with **memory size**.
- Uses **minimal synchronization** to scale up.

FloDB



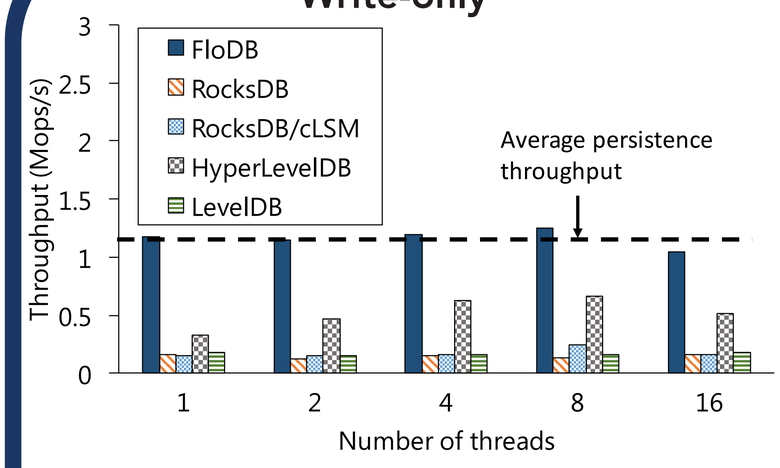
Main Ideas

- Two-level memory component
- Each level: a highly concurrent data structure

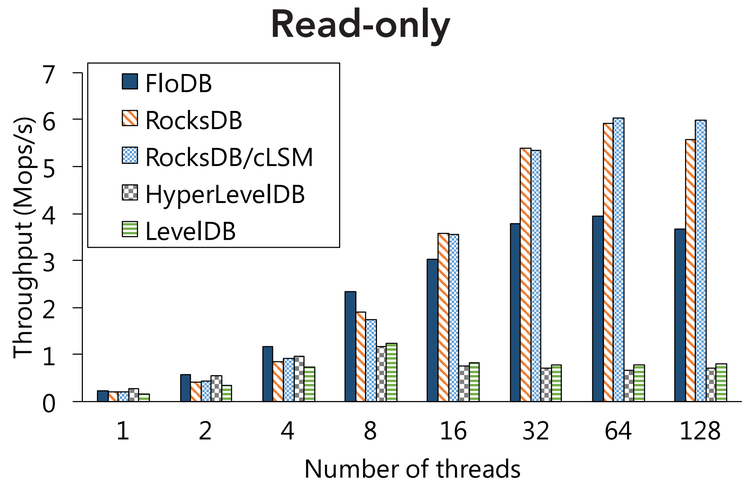
- Small, fast **top-level** + large, slower, **bottom-level.**
- Top-level ~ **concurrent hash table.**
- Bottom-level ~ **concurrent skiplist.**
- Reads/updates/scans proceed in parallel.
- Most **updates complete in fast top-level.**
- Can increase **memory size** w/o hurting performance.
- Data **flows**: top-level → bottom-level → disk.

Results

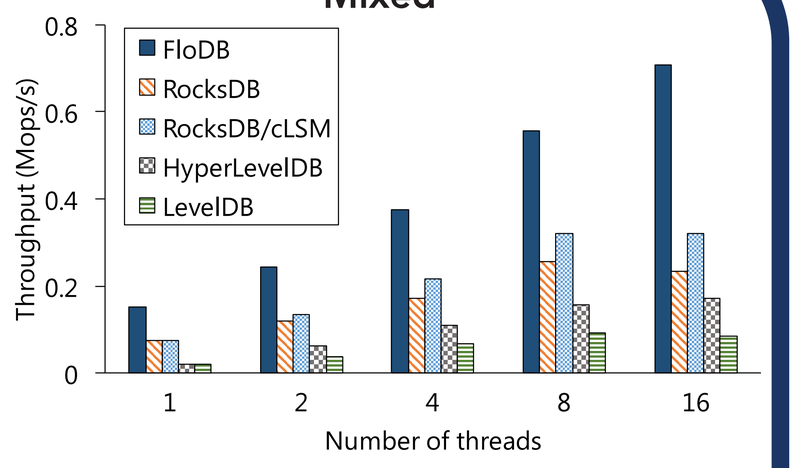
Write-only



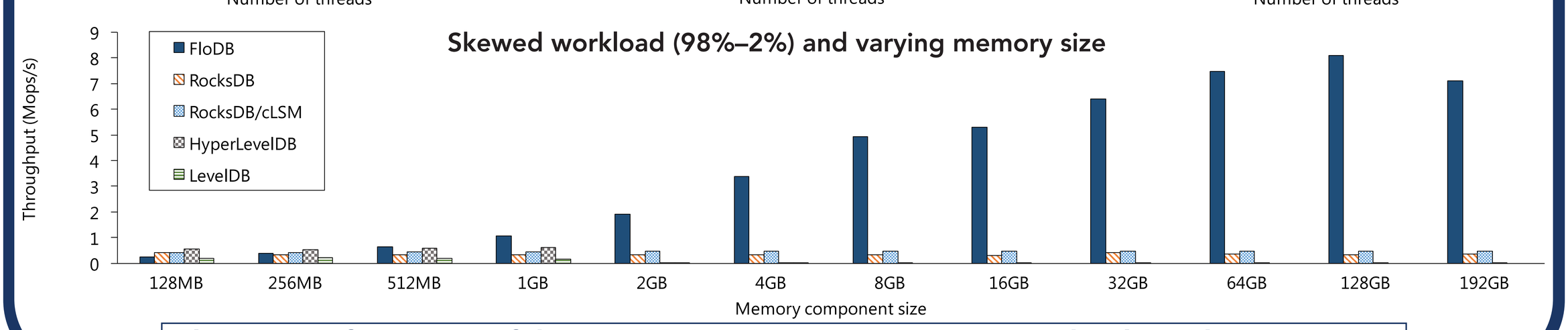
Read-only



Mixed



Skewed workload (98%–2%) and varying memory size



FloDB outperforms state-of-the-art LSMs in write-intensive scenarios and scales with memory size.

Find out more in our paper:

O. Balmau, R. Guerraoui, V. Trigonakis, and I. Zablotchi. FloDB: Unlocking Memory in Persistent Key-Value Stores. In Proceedings of the 12th European Conference on Computer Systems (EuroSys '17)

Check out our website: lpd.epfl.ch/site/flodb

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