Pruning Masstree
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Overview

Motivation: Key-value stores are a critical building block behind many cloud and network services

Goal: Building a space-efficient, high-performance key-value store that also supports range queries

Baseline: Masstree
- The basic structure of Masstree is a concatenation of layers of B+-trees that conceptually form a trie [Masstree, Eurosys’12]

Example
- Initially, two URL keys "edu.cmu.cs.www/~dga/bio.html" and "edu.cmu.www/index.shtml" are stored in the Masstree
- Inserting a third key "edu.cmu.cs.www/~garth/#research" to the original 2-layer Masstree leads to a 3-layer Masstree

Improvement 1: Space-Efficient Masstree

Problem: high memory waste from Stringbags
- Aggressive coarse-grain memory allocation
- Internal fragmentation

Solution
- More effective garbage collection
  - Detect and reclaim unused Stringbags
  - Resolve internal fragmentation
- More efficient memory allocation
  - Conservative (invoke gc before granting new space)
  - Fine-grain to avoid over-allocation

Improvement 2: Static Masstree

Problem: high structural overhead
- Most B*-trees contain very few keys

Solution: treat “cold” keys as read only
- Preserve the trie structure for space-efficiency
- Serialize each B*-tree into a sorted array of keyslices and perform binary search on it for indexing
- Eliminate Stringbags and store key suffixes in place

Evaluation

Workload (based on YCSB)
- Key: URL
- Value: 64-bit integer
- 67% put, 33% delete; then 100% get
- Single thread

Workload (based on TPC-C)
- Key: 15-40B string
- Value: 64-bit integer
- Single thread

Comparison of Improved Versions of Masstree

Range Query Performance