

Build Your Own OctopusDB: Blinktopus Edition

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Scientific Project: Databases for Multi-Dimensional Data, Genomics and Modern Hardware

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Motivation

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⇒ Need for *one size fits all system* (e.g. HTAP)
2. Support OLAP queries for analysis over real-time data (i.e., freshness).
⇒ Explore the techniques related to more interactive queries (e.g. *Approximate Query Processing*)

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2. BlinkDB

- successfully integrates AQP techniques into its architecture.

Conceptual Idea and Implementation

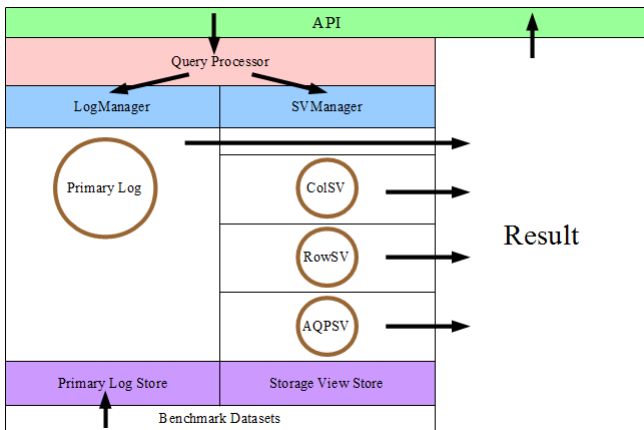


Figure 1: OctopusDB Architecture.

Conceptual Idea and Implementation

Which synopses to pick?

¹<https://datasketches.github.io>

Conceptual Idea and Implementation

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- Equi-depth histograms
 - suitable for range queries;
 - simple to implement and interpretate.

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Conceptual Idea and Implementation

Which synopses to pick?

- Equi-depth histograms
 - suitable for range queries;
 - simple to implement and interpretate.
- Sketches
 - DISTINCT COUNT queries;
 - *HyperLogLog*;
 - *DataSketches* library by *Yahoo!* ¹

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Evaluation Setup

Evaluation Setup

Machine

- CentOS Linux 7.1.1503
- Java SDK 8u131-b11-linux-x64
- 2 Intel(r) Xeon (TM) E5-2630 v3s CPU @ 3.2GHz processors (8 cores each) and 1024 GiB memory

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Benchmark Datasets

- TPC-H datasets (Orders and Lineitems)

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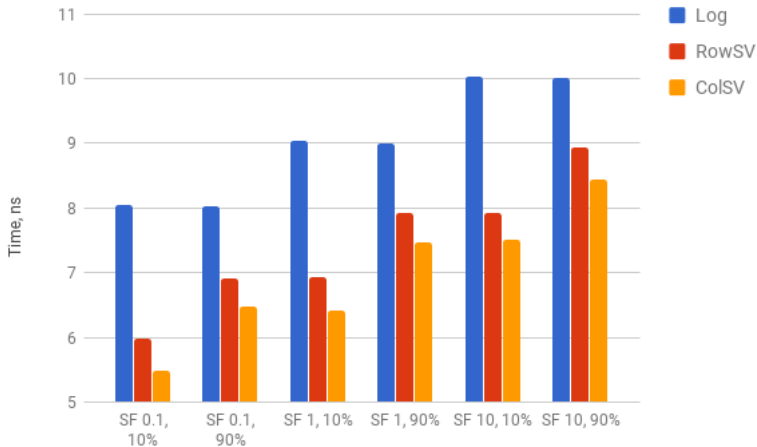
Benchmark Datasets

- TPC-H datasets (Orders and Lineitems)

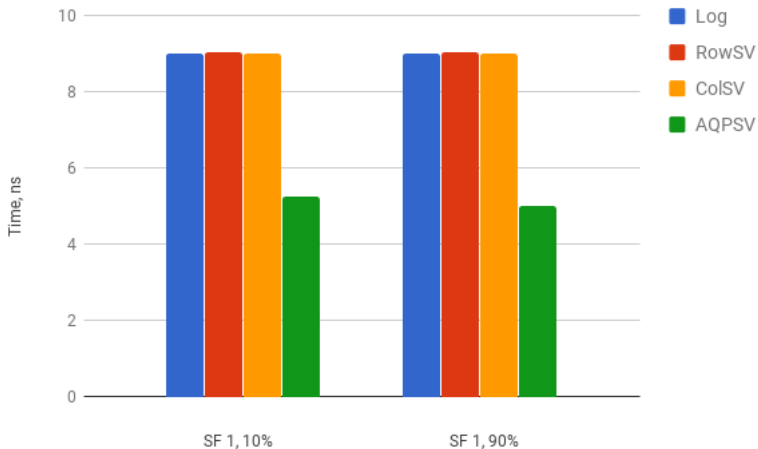
Experiments

1. Average response time for a range query on the Orders table with various scaling factors and predicate selectivity.
2. Average response time for a count-range query on the Orders table. Comparison with an equi-depth histogram.
3. Average response time for a count distinct query on the Orders table. Comparison with a HLL sketch.

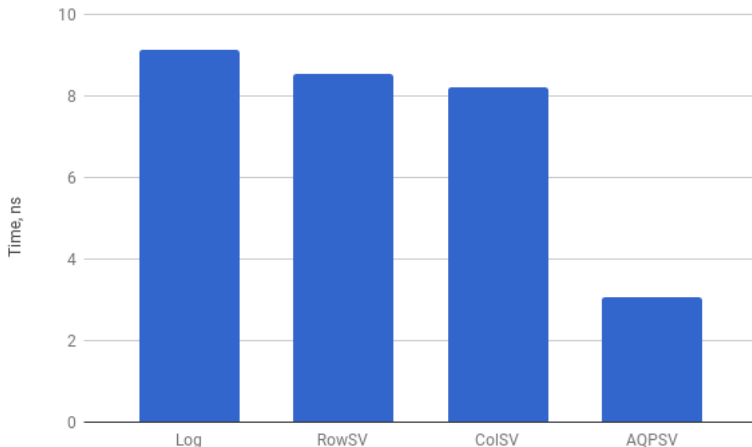
Results. Experiment 1



Results. Experiment 2



Results. Experiment 3



Challenges



Challenges

```
250000000 linesitem were loaded
500000000 linesitem were loaded
500000000 linesitem were loaded
500000000 linesitem were loaded
Start Export count 1
Create CalcW for 10%
Create BaseW for 10%
Start 10%
Log ready
Flow ready
Col ready

!!!! Result: LOG: 1.0700225801610 ; ROW: 0.4727587 ; COL: 5.194757287 !!!

Create CalcW for 90%
Create BaseW for 90%
Start 90%
Log ready
Flow ready
Col ready

!!!! Result: LOG: 1.9852704547610 ; ROW: 0.668200268 ; COL: 2.728436
0000 !!!

campaign: gpus(45,10) - (Blinktopus blinktopus, Blinktopus Tests)

File: DB View Search Terminal: Help
top: 19:43:59 up 5 days, 11:28, 5 users, load average: 1.01, 3.04, 1.05
tasks: 886 total, 1 running, 884 sleeping, 0 stopped, 0 zombie
Meminfo: 3.2 m, 0.0 m, 0.0 m, 90.0 m, 0.0 m, 0.0 m, 0.0 m, 0.0 m, 0.0 m, 0.0 m
Mem Mem: 100077222total, 83373721free, 2208841used, 2370872 buff/cache
Mem Swap: 4334380 total, 2866604 free, 3587896 used, 83382888avail Mem

PID PPID PR NI VIRT RES SHR SPC STI INTR TIME COMMAND
18864 campera 20 0 0 8337 0 1944 10206 5 165 2 20 1 5709.41 1m
21750 blinker 20 0 127466 7886 1448 5 1 0 0 1 0 80.54 1m
50 root 20 0 0 0 0 0 0 0 0 0 0 0 0.82 0m
60 root 20 0 0 0 0 0 0 0 0 0 0 0 0.82 0m
625493 root 20 0 183600 20884 332 5 0 0 0 0 0 0 2.29 15 m
125500 campera 20 0 481936 95448 6616 6 6 3 0 0 2 133.17 1m
2 root 20 0 195660 3940 2272 2 0 0 0 0 0 0 0.18 0m
3 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
4 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
5 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
6 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
8 root 1 0 0 0 0 0 0 0 0 0 0 0 0.00 33 m
9 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
10 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
11 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
12 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
13 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
14 root 20 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
15 root 1 0 0 0 0 0 0 0 0 0 0 0 0.00 0m
```

Challenges

[illegible]
$$5788,41 \text{ min} = 96 \text{ hours} = 4 \text{ days}$$

Related Work

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1. Apache Samza

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- represents data in the various physical layouts;
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3. Snappy Data

- AQP Support;
- uses numerous types of synopses (samples, sketches);
- user defines the level of accuracy and the number of column sets to approximate the results.

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- OLAP queries can benefit from AQP techniques.
- Non-optimized central log as a primary storage is quite prohibitive.

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- extend Blinktopus architecture to support transactional model;

Future Work

- optimize centralized log (e.g. log replication, garbage collection);
- evaluate the efficiency of the concurrency control scheme of OctopusDB;
- evaluate the memory footprint of histograms and sketches;
- extend Blinktopus architecture to support transactional model;
- extend query classes by implementing sample-based data synopses.

Demonstration

Thank you!

Questions? Recommendations? Remarks?