INF FAKULTÄT FÜR INFORMATIK

Build Your Own OctopusDB: Blinktopus Edition

Ali Hashaam, Ali Memon, Guzel Mussilova, Pavlo Shevchenko

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

July 10, 2017

Table of Contents

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*)

Background

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   - uses logs as a primary storage;
   - mimicks several types of systems (OLAP, OLTP, etc.) by representing them as *Storage Views*.
2. **BlinkDB**
   - successfully integrates AQP techniques into its architecture.

Conceptual Idea and Implementation

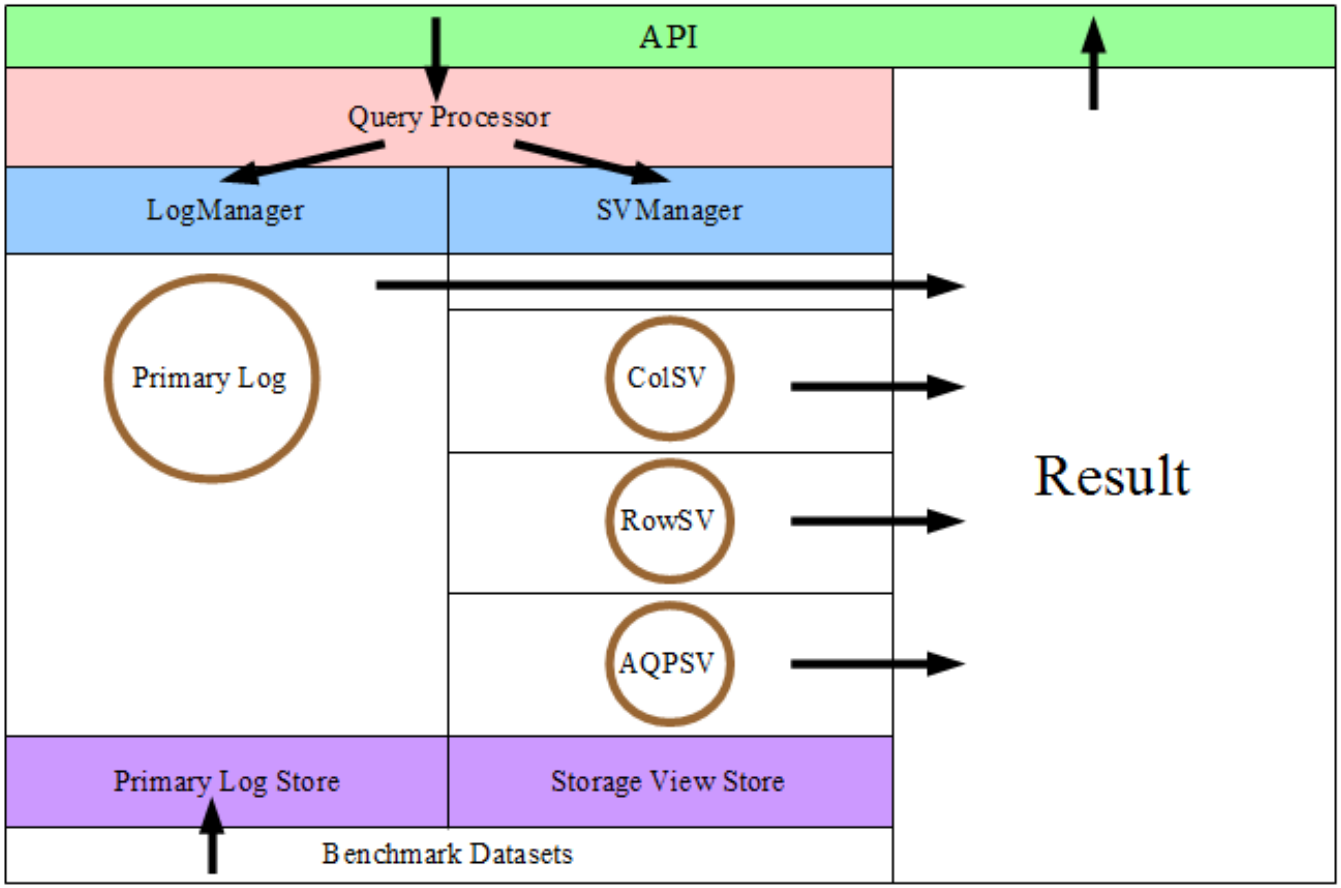

Figure 1: OctopusDB Architecture.

Conceptual Idea and Implementation

Which synopses to pick?

[1] https://datasketches.github.io

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

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Conceptual Idea and Implementation

Which synopses to pick?

- Equi-depth histograms
  - suitable for range queries;
  - simple to implement and interpret.
- 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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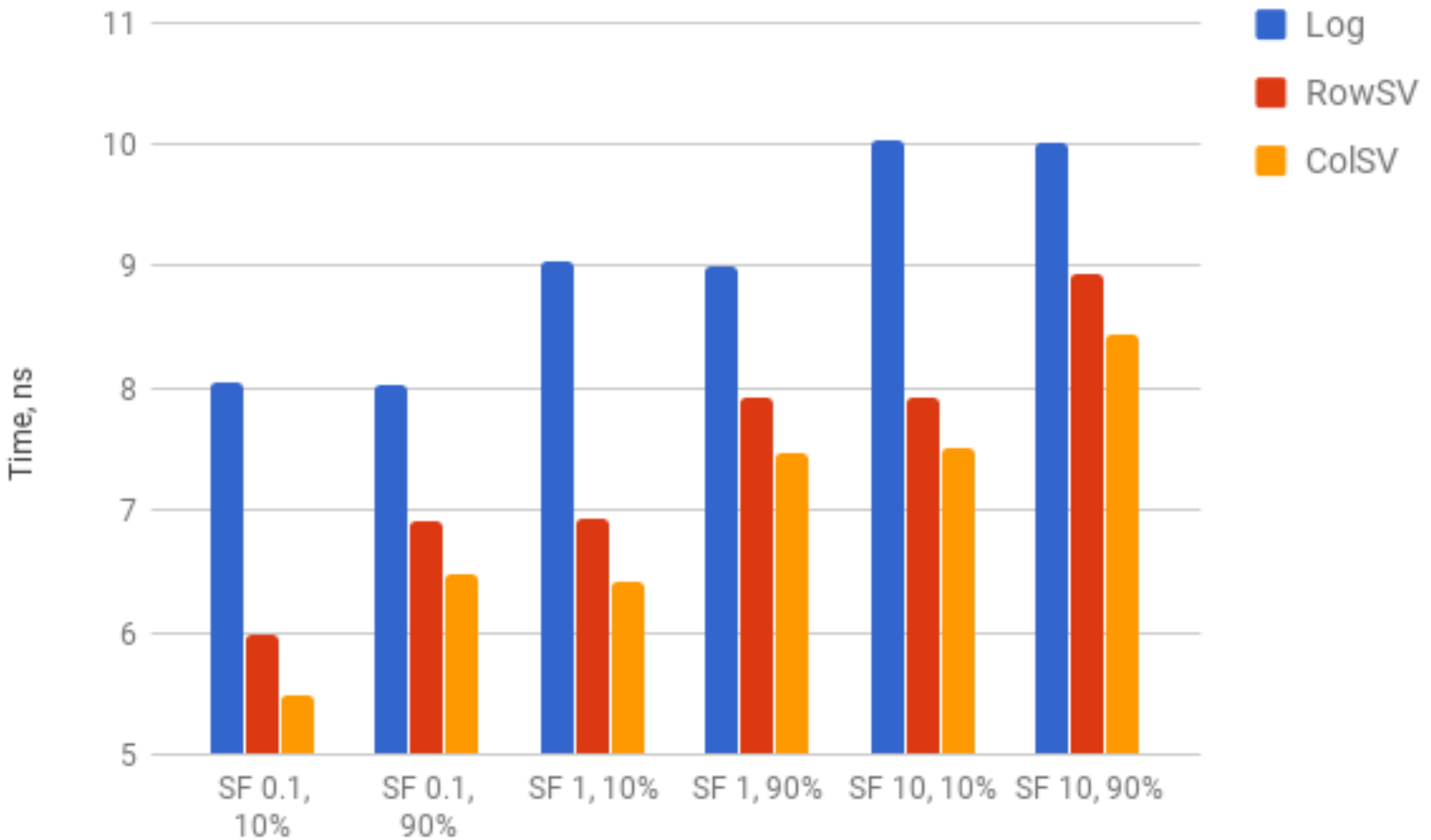
Benchmark Datasets

- TPC-H datasets (Orders and Lineitems)

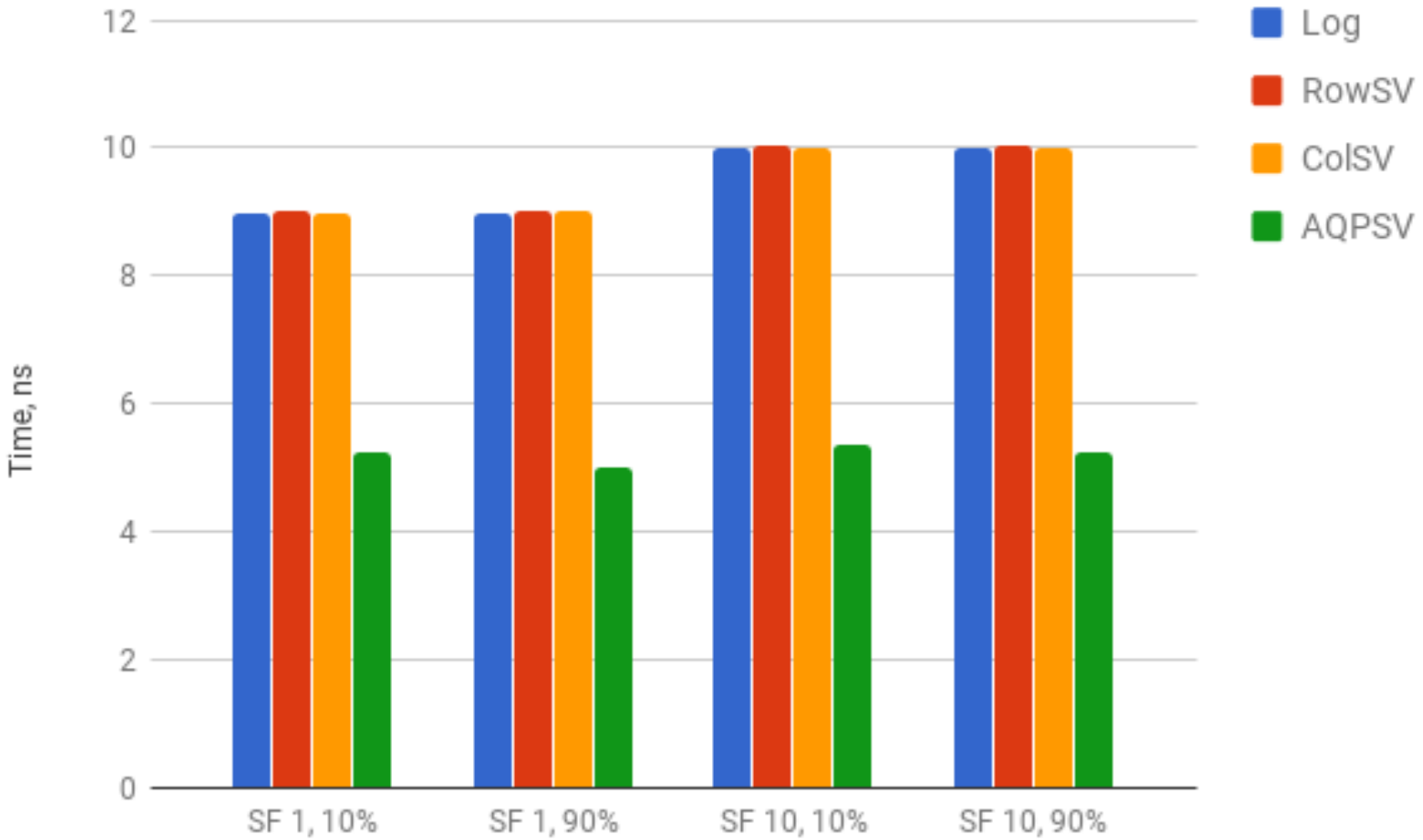
Experiments

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.

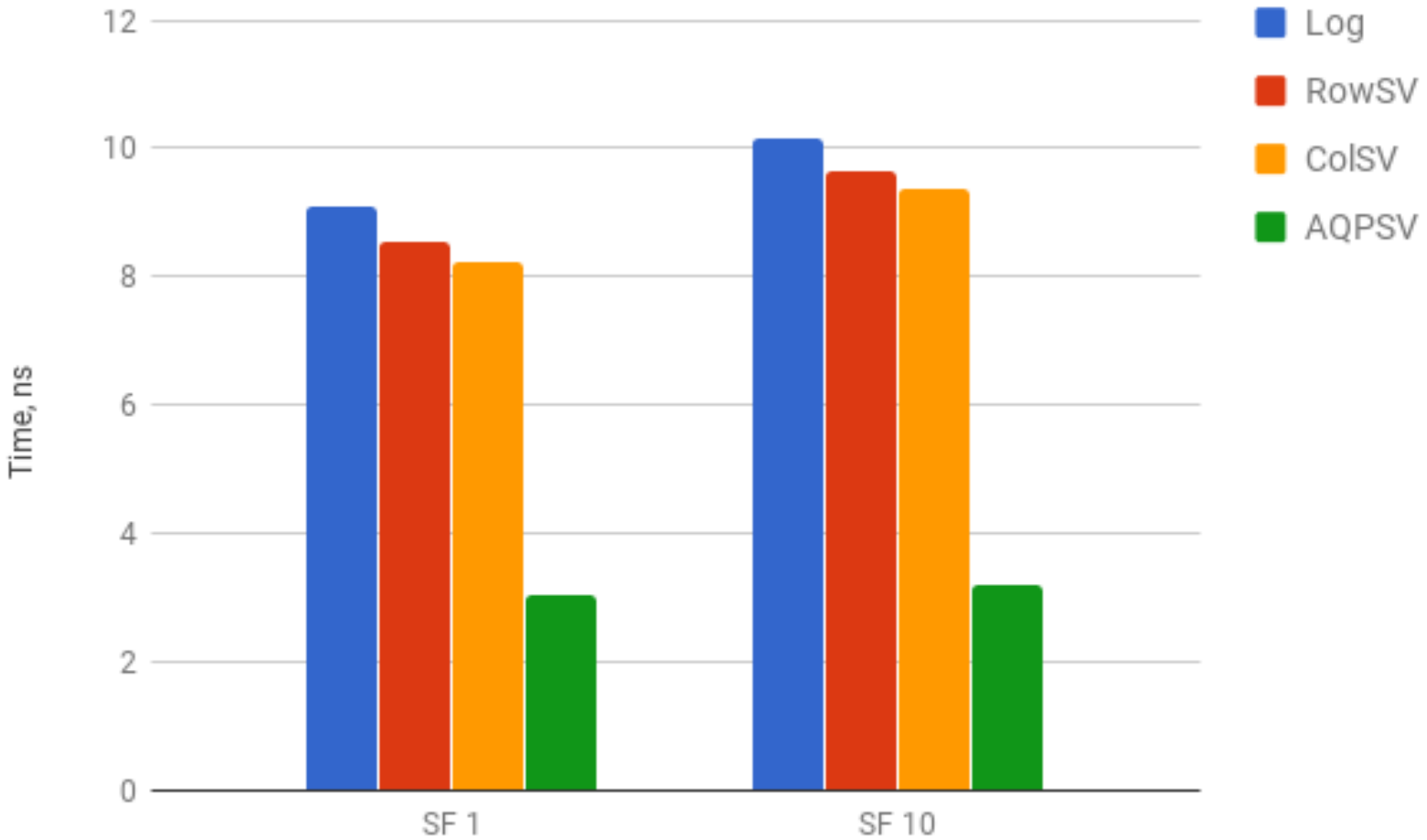
Results. Experiment 1



Results. Experiment 2



Results. Experiment 3



Challenges

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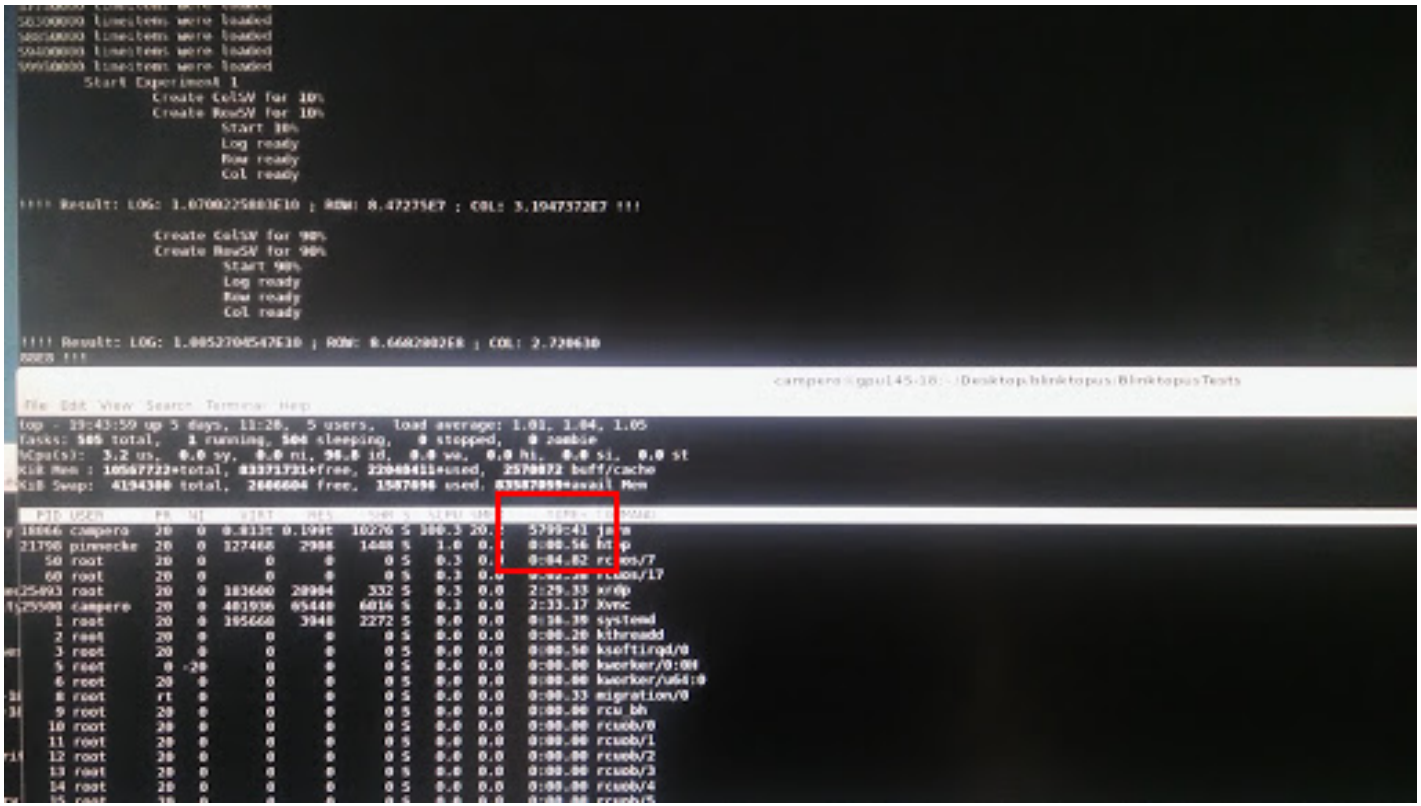
Start Experiment 1
Create ColSV for 10%
Create RowSV for 10%
Start 10%
Log ready
Row ready
Col ready
Create ColSV for 90%
Create RowSV for 90%
Start 90%
Log ready
Row ready
Col ready
top - 19:43:59 up 5 days, 11:28, 5 users, load average: 1.01, 1.04, 1.05
Tasks: 505 total, 1 running, 500 sleeping, 0 stopped, 0 zombie
%Cpu(s): 3.2 us, 0.0 sy, 0.0 ni, 96.8 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 105677224 total, 83371732 free, 22040412 used, 2570872 buff/cache
KiB Swap: 4194300 total, 2606604 free, 1587696 used.
PID USER PR NI VIRT RES SHR S %CPU %MEM TIME+ COMMAND
18066 campero 20 0 8.813t 0.190t 10276 S 100.3 20.3 5799:41 java
21798 pimmeche 20 0 327468 2988 1448 S 1.0 0.0 0:00.56 htop
50 root 20 0 0 0 0 S 0.3 0.0 0:04.82 rcuos/7
60 root 20 0 0 0 0 S 0.3 0.0 rcuos/17
25893 root 20 0 183600 20004 332 S 0.3 0.0 2:29.33 xrdp
25500 campero 20 0 401936 65440 6016 S 0.3 0.0 2:33.17 Xvnc
1 root 20 0 195660 3940 2272 S 0.0 0.0 0:36.39 systemd
2 root 20 0 0 0 0 S 0.0 0.0 0:00.20 kthreadd
3 root 20 0 0 0 0 S 0.0 0.0 0:00.50 ksoftirqd/0
5 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 kworker/0:0H
6 root 20 0 0 0 0 S 0.0 0.0 0:00.00 kworker/u64:0
8 root rt 0 0 0 0 S 0.0 0.0 0:00.33 migration/0
9 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcu_bh
10 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcuob/0
11 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcuob/1
12 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcuob/2
13 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcuob/3
14 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcuob/4

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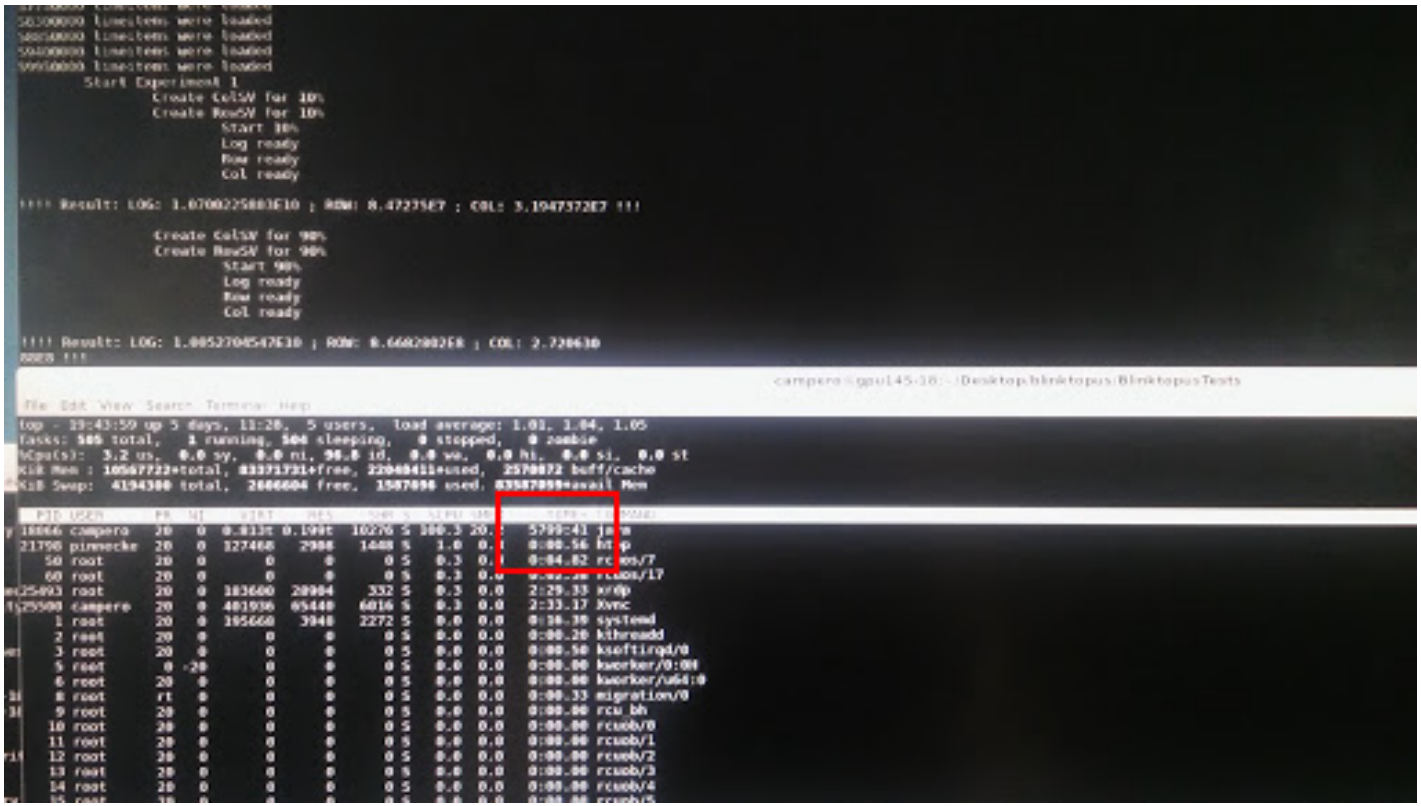

10900 min = 182 hours = 7.5 days

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Related Work

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2. **Rodent Store**
   - represents data in the various physical layouts;
   - provides DBAs a high-level interface to specify the data physical representation by means of storage algebra.
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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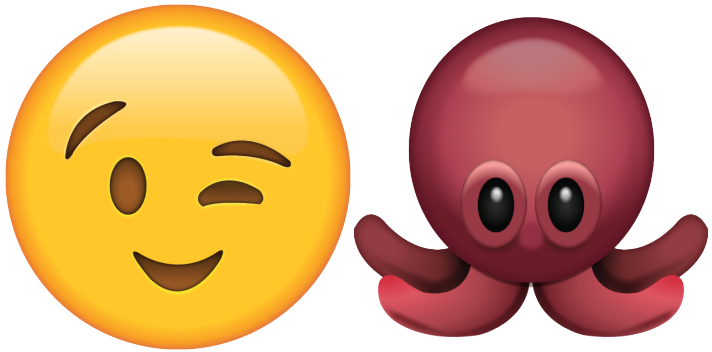
Future Work

- 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?